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Monterey, California. Naval Postgraduate School

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THESIS

OVERHEAD MANAGEMENT GUIDE
FOR AEROSPACE PROCUREMENTS

by

Daniel Dwayne Dietze

and

Kenneth Frank Walter

December 1984

Thesis Advisor:

D.V. Lamm

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This study will focus on overhead costs, their impact on total costs, and an analysis of management indicators deemed most useful in controlling overhead costs. Findings of the study included: administrative indicators, variance analysis, base forecasting, comparison of dollar amounts, comparison of ratios and a new tool called Overhead Cost Analysis Package.

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Overhead
Management Guide
For Aerospace Procurements

by

Daniel Dwayne Dietze
Lieutenant Commander, United States Navy
B.S., University of Nebraska, 1974
M.M., Aquinas College, 1980

and

Kenneth Frank Walter
Lieutenant Commander, United States Navy
B.S., Jacksonville University Florida, 1976

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the
NAVAL POSTGRADUATE SCHOOL
December 1984

ABSTRACT

This thesis focuses on the management emphasis concerning overhead cost control. Senior personnel within the Naval Air Systems Command (NAVAIR) review a multitude of cost information. Due to the nature and complexity of these costs, it is extremely difficult to analyze and interpret cost data and, more specifically, to use these data as a basis for the management of cost control.

This study will focus on overhead costs, their impact on total costs, and an analysis of management indicators deemed most useful in controlling overhead costs. Findings of the study included: administrative indicators, variance analysis, base forecasting, comparison of dollar amounts, comparison of ratios and a new tool called Overhead Cost Analysis Package.

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I. INTRODUCTION

A. FOCUS OF THE STUDY

This study concerns itself with the development of an overhead management guide for acquisition managers. The guide pertains to overhead cost control and the management of those costs by the contractor and the Government. Acquisition managers need indicators as part of their monitoring role. This study will attempt to identify those indicators deemed most useful as management tools to determine if overhead costs are being controlled effectively.

To date, there has been no effective tool or mechanism for contract administrators at the hardware systems command level to adequately gauge how well a particular contractor is controlling overhead costs [Ref. 1: ii]. Moreover, a significant dollar investment is found in overhead costs. Due to this large investment, management needs to evaluate, analyze and recommend areas where cost saving alternatives exist in overhead costs.

B. OBJECTIVES

Management indicators for overhead cost control should be tailored specifically for each defense contractor. This reasoning is primarily due to the peculiar complexity of accounting systems and management control practices within each particular defense contractor's plant.

Under any type of contracting arrangement, it is critical that acquisition managers be very familiar with the contractor's costing mechanisms in order to ensure that the Government is paying a fair and equitable price. Regardless of contract type, the Government shares some of the risk with the contractor.

It is the contracting officer's responsibility to ensure that the Government obtains a reasonably priced contract. He has at his disposal a team of contract specialists and engineers to assist him in evaluating a particular contractor's cost accounting system. He must be able to adequately forecast what are the necessary as well as fair and reasonable costs that the contractor will incur in the performance of the contract.

The objectives of this research are to evaluate overhead costs, look at methods by which overhead costs may be controlled, and how the acquisition manager should view overhead costs during the acquisition process. Finally, an assessment will be made of those management indicators found most useful for this monitoring role.

C. RESEARCH QUESTIONS

In examining the area of overhead cost control, it is paramount that a clear focus be established. This focus should be the central theme of the research. Therefore, the primary research question which this study will attempt to answer is as follows.

1. Primary Question

How can management indicators concerning overhead costs in the aerospace industry be used by Navy acquisition and financial managers in evaluating and monitoring contractor cost control?

To properly expand on the central question, the following subsidiary research questions were incorporated.

2. Subsidiary Questions

a. What are the key management indicators used to evaluate and monitor aerospace contractors and what has been the intended focus of these indicators?

b. How have these indicators been utilized?

c. What are the key issues and problems in the use of management indicators?

d. How should management indicators be applied in order to effectively determine that contractors are properly controlling overhead costs?

e. What new management indicators are appropriate in order to increase the Navy's ability to monitor contractor overhead cost control?

D. RESEARCH METHODOLOGY

During the initial stages of this research, an intensive review was conducted to establish just how much research has been accomplished in this area of overhead cost control within the aerospace industry. This review was accomplished in

order to effectively build this research paper based on a sound foundation of knowledge.

Through the use of custom bibliographies, Congressional reports, cataloged reference material, General Accounting Office (GAO) reports, the Defense Logistics Studies Information Exchange (DLSIE), the Defense Technical Information Center (DTIC), business periodicals and Defense Department reports, an adequate data base was established. Additionally, information utilized in this thesis was derived from interviews with various personnel at Naval Air Systems Command Headquarters, contractor personnel in the aerospace industry, personnel at the regional procurement offices, Naval Plant Representative Offices (NAVPRO), and Defense Contract Administrative Service Plant Representative Office (DCASPRO).

To encourage a free flow of information from the various interviewees; comments, remarks and answers to the interview questions are not attributed. This practice was considered essential due to the risk an individual contractor would perceive if overhead practices and rates could be related to a specific firm.

E. SCOPE OF STUDY

This particular research will develop a management tool for acquisition and financial managers in evaluating overhead costs and in monitoring these costs in aerospace corporations. The study was restricted to large aerospace contractors.

F. LIMITATIONS

In order to put this thesis in proper perspective, it is realized that some limitations are essential. The research was limited by the accessibility of aerospace corporation data. Another limitation to this study has been the constraint of time and ability to visit all aerospace contractors.

G. ASSUMPTIONS

It is assumed that the reader of this thesis has some familiarity with the Federal Acquisition Regulation (FAR), a basic understanding of the various types of contracts, understands contracting organizations and the Government/contractor interface. Finally, it is assumed the reader has an understanding of the elementary aspects of cost accounting.

H. DEFINITIONS

1. Accumulating costs--Collecting cost data in an organized manner such as through a system of accounts.
2. Allocation--A means of spreading costs to a particular contract or program.
3. Acquisition Manager--Those individuals involved in the management of acquisition programs.
4. Contractor--Those prime firms that provide goods and services to the Federal Government.
5. Direct Cost--Any cost which can be identified specifically with a particular final cost objective [Ref. 2: 31.202(a)]. Direct costs are not limited to items which are incorporated in the end product as material or labor. Costs identified specifically with a contract are direct costs of the contract and are to be charged directly thereto. Costs identified specifically with other work of the contractor are direct costs of that work and are not to be charged to the contract directly or indirectly. When items ordinarily chargeable as indirect costs are

charged to Government work as direct costs, the cost of like items applicable to other work of the contractor must be eliminated from indirect costs allocated to Government work [Ref. 2: 31.202(a)].

6. Estimating Costs--The process of forecasting a future result in terms of cost based upon information (historical) available at that particular point in time.
7. External Costs--Includes costs that are basically external to the particular department but internal to the company such as computer services, reproduction charges and word processing services.
8. Facility Costs--These costs include depreciation, repair and maintenance, leasing equipment, utilities, insurance and real property taxes [Ref. 1: 2].
9. Final cost objective--A cost objective that has allocated to it both direct and indirect costs and in the contractor's accumulation system is one of the final accumulation points. A final cost objective is typical of a contract.
10. General and Administrative Expense (G&A)--Any management, financial and other expense which is incurred by or allocated to a business unit and which is for the general management and administration of the business unit as a whole. The G&A expenses do not include those management expenses whose beneficial or causal relationship to cost objectives can be more directly measured by a base other than a cost input base representing total activity of a business unit during a cost accounting period [Ref. 2: 31.001].
11. Indirect Cost--These costs are generally referred to as "burden" or "overhead" and are normally grouped together.

An indirect cost is one which, because of its incurrence for common or joint objectives is not readily subject to treatment as a direct cost. Minor direct cost items may be considered to be indirect costs for reasons of practicality. After direct costs have been determined and charged directly to the contract or other work as appropriate, indirect costs are those remaining to be allocated to the several classes of work.
[Ref. 2: 31.203(a)]

12. Operating and Mixed Costs--These costs include telephone, consumables of general use such as office supplies, postal fees, security police, other outside service costs, Independent Research and Development costs and Bid and Proposal costs [Ref. 1: 2].

13. Overhead Rate--An allocation application computed by dividing a group of indirect costs by a base factor selected for the allocation.
14. People Related Costs--Those costs that include direct labor, indirect salaries and wages, fringe benefits, compensation such as holiday, vacation, sick pay, savings plan, and other personnel related costs such as training, awards, suggestion, travel and relocation costs [Ref. 1: 2].

I. ORGANIZATION OF THE STUDY

This thesis is organized in a manner which provides the reader with an examination of the problems associated with overhead cost control. Chapter II discusses the theoretical framework and background concerning overhead costs which includes: prior initiatives, uniformity and the impact that the Cost Accounting Standards Board had on overhead cost principles. Chapter III discusses overhead costs which includes: Capturing overhead, the problems with overhead, overhead rates and controllability. Chapter IV contains aspects of the aerospace industry and its impact on overhead. Chapter V details the various indicators that contractors use in monitoring overhead and their potential utility. Finally, a summation of the research is discussed in Chapter VI, along with the researcher's conclusions and recommendations.

II. BACKGROUND

A. INITIATIVES

Overhead cost control has received a significant degree of attention over the past few years. In a recent statement to the Northern Virginia Chapter of the National Contract Management Association (NCMA), Mr. Frank Ford, Assistant Deputy Chief of Naval Material for Contracts and Business Management, stated that future Naval contracts would receive increased scrutiny in the following area: overhead rates versus production volume [Ref. 3: 8411-004]. Mr. Ford reminisced that in past years, contractors defended relatively high overhead rates on the basis of relatively low volume. Why now, asked Mr. Ford, with the recent defense build up and a revitalization of the Defense industrial base, are overhead rates not down while volume is up? He went on to say that an initiative had been established to identify major overhead cost drivers but he questioned whether the allocation of overhead based on direct labor was still the best method. This research will address overhead cost control and provide management indicators that may be used to monitor overhead costs.

Indirect costs or burden expenses represent a significant portion of total costs for the contractor in conducting defense business [Ref. 1: i]. Many of these costs are embedded in a pool collection system, a system for the most part that is not

well understood at all levels within DOD [Ref. 4: 1]. Perhaps the most significant aspect confronting the acquisition manager is the inability to compare contractor A against contractor B with simple rules of thumb. In a recent study performed by Commander Donald Hempson under the sponsorship of the Naval Air Systems Command, this point was surfaced:

Equally dangerous from a management oversight perspective is a tendency to compare overhead costs/rates between contractors. Firms are unique in terms of their indirect and direct work force classification systems, their accounting techniques, the composition of facility ownership, the extent of subcontracting, and their fringe benefit allocation techniques.
[Ref. 1: 3]

The Hempson study seemed to succinctly point out what the perceived problem is in the following statement. He concluded that existing tools have been misinformational and in some cases misleading.

In its effort to bring down the escalation in major procurement contracts, the Navy is focusing particular attention on indirect costs. Concerned that overhead costs have grown at an unreasonable rate, Navy management recognizes a need to improve its visibility and management oversight of these costs.

In an attempt to expeditiously fulfill this need, indicators which unintentionally have a high degree of misinformational content are being used as management tools. For example, the fact that overhead costs, when expressed as a percentage of direct labor costs, have grown at a faster rate than inflation over the past five years is being cited as evidence that overhead costs have grown at an unreasonable rate. This particular 'tool' doesn't account for the fact that indirect costs, unlike direct labor costs, are based upon a number of factors which have no relationship to inflation or growth in the Consumer Price Index (CPI). Similar tools are being used which are equally misleading, depicting an overhead cost growth problem where none exists or, at the very least, where the severity is different from that indicated.

Therefore, before a clear assessment of overhead cost growth can be made, it is imperative that overhead cost be analyzed in the following context. First, those costs which rise at a rate equal to or less than the applicable inflation index, should be segregated from other costs. Of those costs which increase faster than inflation, a determination must be made as to whether such growth will reduce long term total cost. If so, such cost growth will ultimately benefit the Navy and, while they should be monitored to ensure the projected cost reductions ultimately occur, should not be challenged unless a more cost effective technique is concomitantly identified. The remaining costs are those which Navy management must properly challenge. In all cases, however, it is imperative that overhead cost control be addressed in the context of total cost control.

None of the above is intended to convey the impression that the Navy should not be concerned about increasing overhead costs, merely that such concern be addressed within the proper framework. Specifically, each contractor must be reviewed separately in order that its uniqueness be accurately reflected in any overhead analysis. Consequently, any management tool, whether predictive or comparative in nature, must be tailored to the firm being analyzed. [Ref. 1: 3]

It was because of this uniqueness of each contractor that the researchers set out to determine what management indicators various contractors used on an individual basis. Those key indicators are contained in Chapter V.

1. Federal Procurement Environment

The Government is not different from large corporations in its buying practices. Many items are purchased on the open market at low catalog prices. However, many of the required items are purchased through sealed bidding procedures. This process involves the issuance of a detailed Government invitation which specifies exactly what the Government needs and the terms and conditions of the contract. However, much of the Government's requirements are for items

of a high technological nature. In these cases, the Government must be able to select a contractor and negotiate a price. The negotiated price is almost totally dependent on the contractor's estimated costs. Under circumstances where these costs are considered uncertain, the Government normally contracts under cost-type arrangements. In this arrangement the contractor is reimbursed for actual costs and paid a fee for contract performance. At the culmination of such contracts, and even under some fixed-price contracts, the Government and the contractor will negotiate the final agreement as to the contract's total costs. Under these circumstances and especially under cost-reimbursement contracting arrangements, the Government clearly has a vested interest in the level of the overhead expenditures that the contractor incurs.

2. Government Cost Accounting

The Federal Acquisition Regulations contain disciplines of accounting policies. Section 31 contains the cost principles that are used in the cost determination of defense contracts. The FAR cost accounting principles carry a significant degree of flexibility. But what is it that differentiates accounting for Government work versus commercial work? We find the answer in the full absorption costing concept.

In commercial practice, absorption costing simply refers to actual product costing in which all of the production costs and fixed manufacturing overhead costs are assigned to a particular commodity. All General and Administrative

expenses are considered costs of the period and not costs of the final cost objective.

However, for negotiated Government contract cost accounting purposes, all allowable costs are assigned to the contract including general and administrative expenses. Because of this unique characteristic the term 'full absorption costing' is applicable. The reason for using the full absorption approach is that for price determination purposes all allowable costs applicable to the contract must be assigned to that cost objective. The concept of 'period costs' is therefore not applicable to government contract cost accounting. [Ref. 5:306]

This concept represents the major difference between Government contract cost accounting and cost accounting for commercial work.

B. UNIFORMITY

The FAR specifically states that in recognizing various organizational entities, cost principles and procedures to be employed must be grouped by organizational type. The overall thrust of this objective is to provide a uniformity in the application of cost principles for a particular type organization or business in which the Government is contracting.

The total cost of the contract is composed of costs directly traceable to the product or service and indirect costs or burden costs allocable to the contract. The contractor makes a disclosure of his proposed methods or cost accumulating procedures and for the most part can choose any accepted method of determining these costs that are equitable and consistently applied. Due to this lack of specificity in delineating how costs are to be accumulated, contractors

may classify, categorize and report costs using different accounting systems. Even though accounting and cost accumulating systems may vary between contractors, there are some definite ground rules that establish when an overhead cost is allowable. The rules are as follows.

The test of reasonableness is to make an assessment whether a particular cost would be incurred by a prudent person in the conduct of competitive business. What is reasonable clearly is a function of many considerations and circumstances involving both the nature and amount of the overhead costs in question. The level of reasonableness is predicated on the desires of the contractor in fulfilling his responsibilities to the stockholders, employees, customers and the level of influence or persuasion on the part of the Government acquisition managers [Ref. 2: 31.201-2].

A cost is allocable if it is assignable or chargeable to one or more cost objectives on the basis of relative benefits received. The FAR specifically states that a cost is allocable to a Government contract if it is incurred for a specific contract, it benefits both contract and commercial work and can be allocated based on the benefits received. If the costs are not directly related to any particular cost objective, they are still allocable if they can be considered necessary to the overall operation of the business.

Since each contractor allocates costs under differing accounting systems, an in-depth evaluation of the particular cost collection and charging systems for the contractor in

question should be accomplished. This evaluation should provide the necessary background of the method of allocating overhead costs, and an assessment of the major cost drivers. The mechanisms employed by contractors in allocating overhead costs are not uniform. Contractors will collect and report overhead costs under many various methods. Some of these allocation methods are contained in Table I.

The third item for determining allowability is the generally accepted accounting principles and practices appropriate to the particular circumstances or the applicable standards promulgated by the Cost Accounting Standards Board (CASB). The fourth is that the costs incurred are in accordance with the terms and conditions of the contract.

C. COST ACCOUNTING STANDARDS BOARD (CASB)

It would be unfair to proceed in this thesis without mentioning the work of the Cost Accounting Standards Board. With the establishment of the Board and their ensuing pronouncements, the manner in which the contractor employed cost principles were to be more uniform and timely for Government review and evaluation. The key concern of CASB was to identify accepted allocation options for Government contracts. Additionally they were empowered to provide direction and uniformity in the way the contractor disclosed its accounting system and executed it [Ref. 5: 303].

1. Background of the CASB

Public Law 91-379, signed by President Nixon on August 25th 1970 created the CASB. The public law promulgated

TABLE I

VARIOUS OVERHEAD POOLS AND THEIR ALLOCATION BASES

<u>OVERHEAD POOLS</u>	<u>PLANTS</u>											
	1	2	3	4	5	6	7	8	9	10	11	12
Manufacturing	B	A	A	B	B	B	A	B	A	A	A	A
Engineering	B	A	A	B	B	B	A	B	A	A	A	A
Material Procurement			F		F							
Material Handling					F	F		F				F
Packing and Crating				G								
Modifications				B								
Spares Handling				C				B				
Launch Services					B							
Tracking					B							
Testing						B						
Nuclear Engineering				B								
Flight Operations				J								
Industrial Products				B								
Logistic Support		A						B				
Field Service			D						A	D		
Customer Service				B								
Occupancy	I							I				
G and A	E	A	D	B	B	C	D	H	C	C	C	C

ALLOCATION BASES

A = Direct Labor \$

F = Material Cost

B = Direct Labor Hours

G = Cost of Shipping

C = Cost of Sales

H = Payroll

D = Total Cost Input

I = Square Feet

E = Number of Employees

J = Flight Time

Source: Martinson, Otto B. Jr., A Standard Classification System for the Indirect Cost of Defense Contractors in the Aircraft Industry (Washington, D.C.: U.S. Government Printing Office, 1969), p. 39

cost accounting standards that were designed to achieve some level of uniformity and consistency in the cost principles employed by defense contractors and subcontractors. These promulgated principles were for contracts in excess of \$100,000.

2. Problems Facing CASB

One of the underlying problems that the CASB faced concerned analyzing contracts. They found that comparing actual costs of contract performance with contract cost estimates was virtually impossible. During the early days of the CASB, it was found that not only were the performance reports not structured in the same fashion as the bid proposals, but contractors were changing their particular accounting methods during the performance of a particular contract [Ref. 5: 303]. Overhead cost control under these circumstances was very difficult.

Due to these difficulties, the Congress empowered the General Accounting Office (GAO) to conduct studies to assess whether or not cost accounting standards should be invoked on defense contractors. Reasons for the need for uniform cost accounting standards were made clear in the Senate and the House and were enacted by the signing of Public Law 91-379 as stated earlier [Ref. 5: 303].

3. Cost Accounting Standards

The CASB was charged with the development of cost accounting standards which would improve consistency and comparability for Government contracts. Three major areas receiving attention included those concerned with consistency,

allocation of costs, and cost accounting for home office expenses.

The initial two standards were created to improve cost accounting consistency. The first standard (Standard 401) entitled "Consistency in Estimating, Accumulating and Reporting Costs," was promulgated to insure that each contractor's practices used in estimating costs were also used in accumulating and reporting costs [Ref. 5: 310-311]. The major thrust of this Standard was to facilitate the preparation of reliable cost estimates used in pricing a proposal, and their comparison with the costs of performance. Standard 402 specified that either direct costs or indirect costs were to be allocated only once to any contract or cost objective. These standards were promulgated to prevent double charging and double counting. The criteria for determining the allocation of costs to a product, contract or other cost objective should be the same for all similar objectives. This point is made clear by the following fundamental requirement:

All costs incurred for the same purpose, in like circumstances, are either direct costs only or indirect costs only with respect to final cost objectives. No final cost objective shall have allocated to it as an indirect cost any cost, if other costs incurred for the same purpose, in like circumstances, have been included as direct cost of that or any other final cost objective. Further, no final cost objective shall have allocated to it as a direct cost any cost, if other costs incurred for the same purpose, in like circumstances, have been included in any indirect cost pool to be allocated to that or any other final cost objective. [Ref. 5: 311]

The purpose of Standard 403 (Allocation of Home Office Expenses to Segments) established criteria for the

allocation of indirect overhead expenses associated with the home office to segments. It provided for the identification of expenses for direct allocation to segments to the maximum extent practical. It provided for the accumulation of significant non-directly allocated expenses into logical and relatively homogeneous pools and an allocation of any remaining or residual home office expenses to all segments of the business based on benefit accrued. The purpose of this Standard was to minimize the allocation of home office expenses to contracts that had no causal or beneficial relationship. Creating standards and requirements as to how costs were to be allocated and captured, provided added visibility for contract administrators to evaluate overhead costs. The Standards, however, did not provide the basis whereby contractor A could be compared to contractor B within the same industry. Contractors may employ totally different accounting systems but meet all of the CASB criteria.

In all, a total of nineteen Standards were developed by the CAS Board, but these first three Standards are the most important for this study.

4. History of Cost Principles and Standards

Prior to the inception of the Cost Accounting Standards Board in 1970, many standards and principles have evolved over time that specifically dealt with overhead cost principles to be applied on defense contracts. These guides or standards evolved due to the needs of Congress. The following is a chronology of events which led to the development of the CASB.

- 1934-1939: Vinson Trammell Act and amendments. This limited profits to the specific percentages of the prices of contracts for airplanes and ships.
- 1940: Treasury decision (TD)5000. This included both principles for determining allowability and guidelines for allocation of indirect costs and was supplemented by TML4-1000.
- 1942: Navy Department "Green Book." Consistent with (TD)5000 and contained the complete set of cost principles used by the Navy.
- 1945: Joint termination accounting manual. This was specifically concerned with allocation of a contractor's total cost to specific contracts.
- 1949: Armed Services Procurement Regulation (ASPR) Section 15. This section contained cost principles applicable to DOD's cost type contracts and was a guide in connection with the fixed-price type contracts. Today Section 31 of the FAR contains the cost principles.
- 1959: Major revision of ASPR Section 15.
- 1970: Establishment of the CASB to develop standards to achieve a degree of uniformity and consistency in cost principles employed by defense contractors. The CASB proceeded to first establish the pertinent rules and regulations. The primary requirement provided for full disclosure and follow consistently their cost accounting practices for pricing proposals and developing contract costing data.
[Ref. 7: 45]

Figure 2.1 contains all of the Standards which have been issued by the CASB.

D. SUMMARY

Overhead cost control has received significant attention from industry as well as the Government over the years. We see the concerted effort to continually require some uniformity

- 401 Consistency in Estimating, Accumulating, and Reporting costs
- 402 Consistency in Allocating Costs Incurred for the same purpose
- 403 Allocation of Home Office Expenses to Segments
- 404 Capitalization of Tangible Assets
- 405 Accounting for Unallowable Costs
- 406 Cost Accounting Period
- 407 Use of Standard Costs for Direct Material and Direct Labor
- 408 Accounting for Compensated Personal Absences
- 409 Depreciation of Capital Expenses
- 410 Allocation of G and A Expense
- 411 Accounting for Acquisition Costs of Material
- 412 Composition and Measurement of Pension Costs
- 413 Adjustment and Allocation of Pension Costs
- 414 Cost of Money as an Element of the Cost of Facilities Capital
- 415 Accounting for the Cost of Deferred Compensation
- 416 Accounting for Insurance Costs
- 417 Cost of Money as an Element of the Cost of Capital Assets under construction
- 418 Allocation of Direct and Indirect Costs
- 420 Accounting of Independent Research and Development and Bid and Proposal Costs

Figure 2.1 CASB COST ACCOUNTING STANDARDS

in the way defense contractors employ cost principles. Now, the mechanisms are in place to accomplish some degree of uniformity.

III. OVERHEAD COSTS

A. INTRODUCTION

After all direct costs have been determined, and are charged to a particular contract, indirect costs are those remaining to be allocated to the various final cost objectives. These overhead costs are to be accumulated by logical cost groupings with consideration of the reasons for incurring such costs. For instance, manufacturing overhead and general and administrative expenses are normally grouped into overhead pools. Therefore, the contractor develops a distribution base common to all cost objectives to which the individual grouping is to be allocated. An additional way that an acquisition manager may identify or categorize these overhead costs is contained in the following section.

B. CAPTURING OVERHEAD COSTS

Overhead costs can be broken down into specific major cost categories including: (1) people-related costs, (2) facilities-related costs, (3) operations and mixed costs, and (4) external costs. People-related costs represent the most significant category of overhead. They include costs of the following types: [Ref. 1: 2]

A. Indirect salaries and wages

B. Fringe benefits and other compensation, non-working hours, insurance plans, saving plans, pensions, and medical plans.

C. Training and travel expenses

D. Consulting Services

Facilities-related costs include the following types of costs:

A. Fixed asset depreciation

B. Repair and maintenance

C. Leased equipment

D. Utilities

E. Building Insurance

Operation and Mixed Costs include:

A. Telephone Services

B. Telegraph

C. Operating and Administrative supplies

D. Expendable Equipment

E. Postage payments

F. Miscellaneous expenses

G. Support for independent research and development costs, bid and proposal costs.

H. Support functions such as scrap yard, cafeteria, employment office

External costs (external to the division, internal to the company) include:

A. Computer services

B. Other allocations

Categorizing overhead costs, accounting for overhead costs, and reporting overhead costs, are complex functions.

One might ask the following question: If one has the mechanisms to categorize, account for, and report overhead costs, what

features or aspects make overhead such a complex problem?

The next section addresses this question.

C. OVERHEAD AS A SPECIAL PROBLEM

Overhead represents a special problem for management because many of the decisions such as allocation methods and indirect staffing are representative of judgemental decisions [Ref. 8: 16]. From the perspective of the profit center manager, too much overhead is allocated to his operations [Ref. 8: 14]. The manager of overhead functions however, such as secretaries, maintenance, security, computer services, and counseling will consider his costs of operation strategically important to the conduct of the business.

Overhead therefore, represents a unique management problem for the contractor and Government. Different motives and attitudes are at work. Additionally, in the overhead area, there is no clearcut relationship between expenses and profits as they exist with production. This happens because the effect of overhead on profits is only seen in the aggregate. It is due to the hidden mechanisms and the inability to readily identify areas where costs might be out of control that make overhead cost control difficult [Ref. 8: 21]. The following example portrays this problem: A contractor might be quick to add additional engineers in order to eliminate the need for direct manufacturing labor efforts. His position may be justified on the premise that one engineer may replace more than one hands-on operator. However, the researchers have

found that those managing overhead functions may not necessarily seek the tradeoff of direct salaried individuals. Staff personnel might be hired on the basis of anticipated company growth. Growth frequently means greater overhead expenses.

Overhead expenses are perhaps one of the most difficult areas to manage when a contractor is experiencing fluctuations in growth patterns [Ref. 8: 21]. This is particularly so because they usually do not relate to volume, as one would expect. As mentioned earlier, the statement was made by Mr. Ford that contractor's overheads were being justified by low volume in the past and now with an increased business base, the overhead rates should decline. For many contractors, the long-term trend is not toward a smaller percentage of overhead, as a percentage of sales, but rather the same percentage. "This is equivalent to saying that we have not learned how to operate more efficiently in overhead areas with increasing size" [Ref. 8: 21].

Up to this point some of the areas that make overhead costs a special problem have been identified. Next the issue of overhead cost controllability will be discussed.

D. CONTROLLABLE VERSUS NON-CONTROLLABLE OVERHEAD COSTS

The researchers found when evaluating overhead, one must be able to differentiate between controllable and non-controllable overhead costs. In the short run, there are overhead items that are clearly not controllable. They typically include

such items as real estate taxes, social security payments, union package costs, and depreciation. They do not lend themselves to the same type of management review as many other overhead items do [Ref. 10: 12].

Management is responsible for these items but the amount charged to a plant for local real estate taxes is by no means amenable to the same sort of management review, analysis, and control as are many other items of overhead. [Ref. 8: 25]

Controllable overhead includes such costs as the people-related fringe, compensation packaging, and some costs resulting from some indirect staffing decisions. However, an item such as production engineering is considered to be a manageable category of overhead [Ref. 8: 25]. It can be evaluated, reviewed, budgeted, adjusted upward or downward, and controlled by managers. "The distinction drawn here is between costs that management has some chance of improving and those it can scarcely hope to do much about" [Ref. 8: 16].

E. OVERHEAD RATES

Within most manufacturing-type organizations, an attempt is normally made to relate all costs of production to a specific product [Ref. 6: 35]. Through standard accounting mechanisms, direct costs can be identified to a particular product. The use of overhead rates is the process by which overhead costs are allocated to specific contracts. These rates are normally computed by dividing a pool of indirect costs, such as general and administrative expenses by an allocation base.

These pools are the result of bringing together various operations into groups, in which each overhead pool will consist of a number of cost centers for the accumulation and management of costs [Ref. 6: 36]. The total costs that are accumulated in a particular pool will also include those costs generated in the pool and a proration of costs generated in other pools based on a particular usage factor. For instance, "Depreciation of the building may be prorated to all pools on a square foot basis" [Ref. 6: 36]. This base can be direct labor hours, direct labor dollars or any other similar base considered to be equitable. Table I identified several such allocation bases.

Usually, there are two types of overhead pools: one normally associated with the production function and the other related to ancillary services. Production pools are assigned to specific contracts whereas service pools are in support of the entire contractor's plant. The service pools must be distributed against the production pools. The distribution is made on the basis of benefit accrued to the production pool. But as contractors point out, the benefit is difficult to measure.

Table II depicts how a particular overhead rate might be computer for two production pools.

First, a collection of all general and administrative costs is completed. These costs must in turn be distributed against the production pools in order to allocate all indirect

TABLE II
OVERHEAD RATE CALCULATION

COSTS	MANUFACTURING OVERHEAD EXPENSES	ENGINEERING OVERHEAD EXPENSES	G and A EXPENSES
salaries	\$ 50,000	\$ 28,000	\$ 11,000
benefits	8,000	4,000	3,000
consumables	5,000	1,000	500
insurance	500	200	100
rentals	2,450	1,000	500
telephone	200	250	150
data processing	<u>0</u>	<u>0</u>	<u>1,000</u>
Total Indirect costs	66,150 (65%)	34,450 (35%)	16,250
Allocation of G & A	<u>10,685</u>	<u>5,565</u>	
Total indirect costs in production pool	76,835	40,015	
Direct labor hours (DLH)	20,000	12,000	
Rates per (DLH)	3.84	3.33	

overhead costs. Table II shows total general and administrative costs as \$16,250. A G&A rate of 16.153% is computed by dividing the total production pool costs (\$66,150 + \$34,450) into the total G&A expenses (\$16,250). The rate is then applied to the total indirect cost for each production pool in order to allocate the G&A costs. Total indirect costs are then divided by the chosen base (DLH) to arrive at the overhead rate per direct labor hour for each pool. In this example, the G&A pool is allocated to the Manufacturing and Engineering overhead pools. In reality, this usually is not the case. The purpose in this instance is to illustrate how a particular service pool may be allocated to a particular production pool.

"This procedure of constructing overhead rates is generally applied throughout industry" [Ref. 6: 38]. However, it is not the intent of this research to evaluate each method of overhead allocation because there are considerable differences among contractors in establishing overhead pools, defining the costs that comprise pools, and the basis of allocating these costs to the contracts.

A significant statement was made by Otto Martinson in that, "...indirect costs are viewed primarily through overhead rates" [Ref. 6: 38]. Therefore, acquisition managers should, prior to negotiating overhead rates, make a determination of: [Ref. 6: 38]

- (1) The overhead expenses and rates that the company has been experiencing, including trends and an assessment of whether these rates are reasonable.
- (2) The particular bases to which the contractor has been applying overhead costs and whether these bases are appropriate.

- (3) The overhead rate that should be in the Government price objectives on the basis of information determined in (1) above.

These rates are viewed critically by contractors because it is the mechanism for recovering indirect costs. Overhead rates provide the contractor with a recovery view of indirect costs.

The recovery view may provide a useful and necessary framework for pricing indirect costs on a contract, however it should not be used as the focal point of the evaluator's analysis. [Ref. 6: 117]

The problems associated with this recovery view include:

[Ref. 6: 40]

- a. Rates are aggregate views. They fail to identify the factors driving overhead costs.
- b. Rates are only allocative.
- c. There may be little commonality of rate composition between companies.
- d. Rates are created on bases that are convenient for accounting purposes.
- e. The rate network encourages a fragmented review and analysis of costs should be examined on a total plant basis. This would seem to show that controlling overhead by use of rate management is not the answer.

When conducting interviews with various personnel, both in and outside the Government, attention to cost drivers of overhead seemed to become the focus of the interviewee. They became very concerned with analyzing the reasons for incurring these overhead costs. The researchers found that there were several issues and aspects that affect overhead cost control.

F. CONTROLLING OVERHEAD COSTS

Why should overhead costs be controlled? There is a great deal of complexity in attempting to trace overhead costs, and to allocate them on some rational basis. Controlling these costs are of prime interest because they can affect baseline prices and profit levels for future contracts. Some acquisition managers are concerned that overhead costs have grown at an unreasonable rate. For example:

While overhead costs are essentially within the control of the individual contractors, many Navy acquisition managers believe that they are not effectively controlled and that as a result, prices are too high.
[Ref. 11: ii]

The management of major weapon systems acquisition resides with the program office. This office is responsible for ensuring that cost and schedules are progressing in accordance with the contract. As such, they review indirect overhead costs as an essential element in their monitoring. One mechanism that the acquisition manager has to evaluate these indirect costs is through overhead rates. The researchers find this to be a difficult indicator in evaluating overhead costs. Rates in themselves are not indicative of control. Forecasting the business base and assessing a commensurate level of overhead is a complicated process.

1. Aspects Impacting Control

When the total overhead dollars increase faster than sales, the increase is usually at the expense of profits. "But the aerospace supplier is a special entity," stated one contractor involved in this study. Tooling up and staffing

a production facility to produce to a projected business base, only to find out programs will be cut in half or stretched out, only adds to the problem of overhead cost control as yet another contractor stated. Aerospace contractors are not to be categorized as a producer of durable goods, as was "firmly" pointed out. They produce nonstandard, highly sophisticated aircraft on a relatively low volume basis. With a continually changing business base one contractor emphasized that overhead cost control is difficult. But where should one look to determine if the contractor in question is making efforts in controlling his overhead costs? The researchers found that executive control is an important aspect to be considered in answering this question.

2.- Executive Control

The chief executive's attitude and philosophy pertaining to overhead cost control will have a profound effect on the company's image as being either a free spender or spend thrift [Ref. 8: 67]. This research at a particular aerospace contractor identified a centralization of control and decision-making at the top. The chief executive was personally involved in cost reduction measures. For instance, all dues to associations or membership fees with various organizations had to have the chief's endorsement. Another overhead cost control measure placed on the company pertained to the elimination of first class travel on corporate business.

Another vehicle or mechanism employed at one aerospace contractor that had a positive effect on overhead cost control

was vested in a decentralized controlling action in executing the operating budgets. In formulating the budget, the operating divisions project their individual requirements, and the financial planners project what the operating budgets for a particular operating division should be. After intense negotiation, the chief executive mandates the budget and the dollars available for the operating divisions during the budget year. The dollar levels are not flexible. The budget holders are forced to think twice about inventory buildup in supplies and materials, or the requisitioning of additional people. Rather than micromanage at the staff level, the decision-making authority has been delegated to the operating divisions. In order to incentivize the division managers, a reward system is used to recognize spending under budget. On the other hand, when an operating division manager goes over budget, corrective action is taken.

These are just a few of the aspects that an acquisition manager could review as part of his monitoring role. Some companies will prefer to micromanage at a higher level than its counterpart. Each contractor in this study indicated the positive features in their system and the real effect that their overhead philosophy had on cost control.

From the various considerations already mentioned, one can easily see that controlling overhead is a special problem. "Too often, management waits until the overhead-profit squeeze becomes critical before acting" [Ref. 8: 43]. Under these conditions, management has, in many cases, used across-the-board

cuts in all departments. One particular aerospace contractor indicated that across-the-board cuts can be severely detrimental not only to employee morale but also to the organization. In fact, some areas are trimmed but battles are fought in areas where the tendency to build empires exists. This in itself is a management indicator.

The ebb and flow of cost control is tightened by the chief executive. In times of reduced production and slow downs, costs at the lower levels are reviewed more closely, said one contractor. The staff is put in the role of monitoring more closely over and above the normal functions. The staff load may increase. The staff span of control will also increase and sometimes will require additional personnel to accomplish the task. Planning for overhead sometimes creates an illusion whereby hypothetical formulas are used to report overhead as a percent of the annual sales figures. However, the problem of relating levels of overhead to sales volume overshadows the validity in using such measures. If this rule of thumb was applicable for overhead, companies would have employed it years ago. They would be able to determine staff capacities based on sales. For instance, "...for every ten million in sales you should have 0.8 lawyers, 1.3 internal auditors and so on..." [Ref. 8: 33].

One contractor indicated that anytime overhead costs are being justified on a comparative basis, the prudent manager should question this methodology. Product lines and mix will differ within a particular industry. Contractor A

will employ a set number of lawyers or accountants which may be totally different than Contractor B. His justification will be predicated on those costs considered necessary for conducting his business.

Overhead, therefore, is an executive responsibility. The company's earnings will be significantly affected by the level of overhead expended. An available mechanism that the executive will have at his disposal or an indicator he can use to control overhead is through budgeted projections. He may delegate responsibilities to subordinates to manage individual overhead accounts and monitor performance against the projections or he may choose to form his own cost containment board to manage overhead at higher organizational levels. Chapter V will discuss the use of flexible budgets as a management indicator used by some aerospace contractors. One of the most perplexing and complicated areas that face the contractor is the continual desire of the subordinate to press for more spending above and beyond the projected plan. Every sort of rationalization will be used to sway the chief executive or budget holder in budget decision-making [Ref. 8: 34]. The rationalizations that may be used will concern the following:

The improved economic outlook, recovery of lost markets, greater profitability, the precedence of competitive action, economics to be gained from the new service, overloading of present staff, and image of the company.
[Ref. 8: 34]

3. Overhead Cost Drivers

There are causal factors that tend to explain overhead cost behavior. These factors are its variable nature and fixed nature.

The first (variable costs) will tend to vary in direct proportion with volume of manufacturing, indicated one contractor. Some costs, such as supplies, will vary to the level of production. Administrative supply costs, for example, are proportional to secretarial production work. However, some variable costs may vary with volume for different reasons.

Certain costs are variable because of some inherent functional relationships between those costs and a related volume measure. Such costs are sometimes described as engineered variable costs. For example, freight and material handling costs are projected at a fixed rate per unit of materials shipped and received. That fixed rate is based on experience, adjusted for anticipated inflation. Factory supplies and consumable tools are planned in relation to the volume of direct manufacturing labor hours. These relationships reflect physical realities of operations. Fringe benefits generally vary with the amount of labor cost, the number of labor hours worked, or the number of employees. [Ref. 4: 10]

Therefore some overhead costs vary with volume for different reasons. Some management indicators pertaining to these relationships will be developed in Chapter V.

Many variable costs are reflective of management policy and strategy. One contractor may plan his travel expenses based on past experience or perhaps as a fixed cost whereby each department is provided a travel budget for the year.

"As long as management continues to exercise its decisions in the same manner, these cost ratios are useful for planning

and control" [Ref. 4: 10]. Therefore, the acquisition manager must be cognizant of a contractor's forecasting or planning policies to determine if the same methods are consistently applied. Chapter V identifies various management indicators found in the contractor's Planning Control and Budgeting system.

The other aspect or driver of overhead costs are of the fixed nature. They do not change due to changes in production volume. The fixed costs include depreciation and property taxes and according to one contractor, includes the minimum acceptable level of building maintenance necessary to maintain facilities and equipment in safe operating condition. These costs are representative of overhead items that cannot be significantly changed in the short run.

There is no implication here that it is discretionary with management whether any cost is incurred or not. It is only the amount of that cost in a given period that is discretionary. [Ref. 4: 12]

Overhead functions such as staff and external costs are mostly services performed by people [Ref. 8: 29]. These services lend themselves to continuous review regarding management practices. "Management discretion may be to spend amounts that the company can afford, and what is affordable may be regarded as a function of the sales revenues available to cover the costs" [Ref. 4: 12]. But what is the most significant factor that seems to drive overhead costs? The respondents said that people-related costs are the most significant. However, contractors employed differing philosophies concerning these costs. For instance, one contractor has created a

very paternalistic, people-oriented company. In order to accomplish this they provide attractive health care plans, fringe benefits, pension plans, savings plans, stock options and in some cases early-out retirement bonuses (The Golden Handshake). "Retention of quality people costs big bucks," said one contractor. On the other hand, another contractor may be operating with a strong union work force where compensation and fringe items are heavily negotiated. Ensuing company directives trying to reduce costs associated with utility usage, or telephone service is only reaching the tip of the iceberg in the total overhead arena, as one contractor indicated.

Instituting and pointing out to the contractor potential areas of opportunity that have an impact on cost reduction can be extremely beneficial. One particular case, and one not associated with an aerospace contractor, concerned itself with medical care referral practices. It was evidenced that the costs of this overhead function were extremely large. People were being referred to doctors for all types of health care. There was no control on the referral process. As a remedy, a referral physician was hired and only on his prescribed diagnosis were medical services to be performed. It was estimated that his salary earned itself ten-fold in one year.

4. Differing Philosophies

The problem of overhead control is additionally affected by the differing philosophies between line and staff management. In those line functions that are associated with production

operations, the researchers found a standard level work force. Line management will tend to handle the peaks and valleys of production with a constant work force either through use of overtime hours or detailing people to other assignments. Only during significant increases in expected production will the contractor add more employees. The philosophy here is to be able to handle the average expected work load at all times.

Contrary to the line philosophy, staff managers tend to build up to support the maximum load that they can anticipate [Ref. 8: 37]. Managers of functions such as legal, accounting and secretarial services, regret not being able to support top management [Ref. 8: 37]. They believe it could create a situation whereby they would receive more criticism for not promptly processing their workload than they would for increasing personnel-related expenses. Chapter V will discuss the use of employee mix, such as indirect versus direct employees, as a management indicator.

Indirect staffing decisions sometimes lead to over-staffing. Due to the philosophy of continually supporting a maximum workload, there is actually insufficient utilization of overhead functions at any given point in time [Ref. 8: 38]. Employees who do not have enough work to do will become dissatisfied and if they have any initiative at all, they will present the image that they are doing things which are useful [Ref. 8: 38]. This type of philosophy results in empire building because people perceive that positions become indispensable. The researchers noticed that some contractors were

reluctant to discuss their indirect staffing criteria and what constitutes a reasonable level of staffing.

The researchers found that aerospace corporations, in general, are reluctant to reduce their staffing levels associated with overhead functions such as computer services or accounting departments. Any attempt to change the sense of direction and the way business is to be carried out would be too far-reaching, said one contractor. You would not find a company in this industry reverting back to manual book-keeping or eliminating the data systems divisions. This is additionally supported by the philosophy that the services are already in place so why not use them to the maximum extent possible. This is not to say that this philosophy permeates the industry. Some contractors view overhead functions differently. Such differences will be explored in the next section concerning the culture of overhead.

5. The Culture of Overhead

The researchers observed that when contractors attempted to justify a particular level of overhead, (e.g., fringe benefits, compensation, or indirect employee staffing), a culture surface that dealt with the judgemental areas of reasonability. There is no quick and easy way in which one can determine what overhead items are essential to a particular company or how much of any one type is necessary. There will always be the classic case where the manager in charge of a profit center feels as if he or she is receiving an unreasonable portion of allocable overhead. For example, there

is no simple answer to the question of just how reasonable the charge for computer services is. It is equally difficult to project the benefits of continual computer investments that the Government will receive, said one acquisition manager.

The acquisition manager may identify areas of opportunity, such as data systems services, as a special overhead problem. The researchers noticed this to be the case during interviews conducted with aerospace companies. For instance, some aerospace corporations have established computer services which derive most of their revenues from internal customers. "There is an obvious concern and general lack of understanding regarding the level of competitiveness of prices offered to these internal customers" [Ref. 1: 34]. Aerospace corporations are diversifying past their risky military base. In order to enter the highly competitive computer services base, domestic and international, some corporations will rely on the stable internal customer base, such as those by the aerospace divisions, to absorb the overhead costs [Ref. 1: 35]. This in turn helps the contractor reduce his per unit charge in those market segments in which he is trying to compete. This is one reason why comparison shopping outside the corporation is not performed. The degree of management flexibility is eroded and, in some instances, cost effective decisions are not being executed.

In order to aid in the accomplishment of overhead control, the researchers found that one contractor executed his operating budgets in a decentralized manner. An indication

of the level of control being exercised is predicated on the visible justification or nonjustification associated with an overhead decision. If a manager feels its worth paying for, it should for the most part be considered justified [Ref. 8: 43]. The decision again goes back to the company culture concerning these matters. Some managers will want staff specialists and overhead engineers on the scene for every decision. However, when the costs are charged to the profit centers or programs for such services, their use tends to be minimized. The researchers noticed in this instance that the decentralization of budget control had a positive effect on overhead reduction. However, company edict may provide management no option with these consulting services, the only control point in those circumstances rests with the executive that decides these policies.

Overhead control is a function of the attitudes and philosophies of corporate management. It is because there is a lack of a consistent attitude toward overhead control that so many companies go through concentrated efforts to get overhead costs back in line with the budget.

When an overhead rate gets too high, as compared to projected levels, it provides a signal or indicator that for the present level of business, an imbalance may exist between production activities (direct costs) and support services (overhead). Managers indicate that with an increased business base, the overhead increase will be satisfactorily absorbed. However, contractors interviewed are continually alert for

this relationship. The researchers noticed that contractors felt that overhead control was a function of how well actual overhead expenses were tracking against budgeted levels. As budgets are executed, variances may occur and management's response and actions taken on those variances signify the level of overhead control being exerted.

Therefore, one can see many aspects that impact a contractor's overhead cost culture. Many overhead costs lend themselves to the judgemental regions of reasonability and the researchers found that contractors use differing management styles in executing their operating budgets. This strengthens the statement that it's difficult to compare contractor A with contractor B. Overhead cost culture is company unique.

G. SUMMARY

This chapter highlighted the theoretical framework associated with overhead costs. It addressed various aspects that one might consider in obtaining a basic knowledge about overhead costs in the aerospace industry. The researchers found that overhead management is perhaps one of the most difficult areas for acquisition managers as well as company management due to the judgments made in controlling overhead costs. In order to obtain an increased awareness of the pressures and aspects that affect corporation strategies and planning efforts which ultimately affect overhead costs, Chapter IV discusses the various environmental aspects that drive overhead.

IV. NATURE OF AEROSPACE ENVIRONMENT

A. BACKGROUND

Before one can evaluate various management indicators and how an acquisition manager should use them in maintaining overhead cost control, it is necessary to evaluate the environment that aerospace contractors face.

The projection of the business base is key to the overhead expenses that will be budgeted said one contractor. As part of the forecast, contractors make an assessment of this base on many aspects. An assessment is made on the general environment, one on the basic business environment and an assessment on the potential DOD market business. When monitoring indirect costs, understanding the corporate outlook and strategy is a necessary ingredient.

B. TECHNOLOGY

The technology forecast is perhaps the most difficult aspect for the contractor to assess. However, one contractor said, "technological breakthroughs are unpredictable." It is because of this unpredictability that most firms find it difficult to forecast and control associated overhead costs.

The aerospace industry is a market driven industry. More and more technical advancements are demanded by the customer. Additionally, public consensus demanding cleaner and less noisy aircraft continually affect the strategies and research and development efforts by aerospace corporations. Technical

advancements come from a variety of sources. "The radar, jet engine, swept wing and much of today's modern electronics are only a few examples of international contributions" [Ref. 12: 32]. Because of the lengthy time period between concept to full-scale development, proprietary data has a tendency to leak out to the competition. Research and development expenditures are necessary if a particular company wants to stay competitive in the aerospace industry. "The high price tag for such efforts results in low profit margins and requires a large production base to spread the costs against" [Ref. 12: 32]. Therefore, one may conclude that survivability to the aerospace contractor is predicated on booking orders.

C. THE MARKETS

The government market is substantially immune to downside risk from environmental shocks, said one contractor. It is not depressed by economic slowdowns, oil embargoes, famine or other minor political upheavals said another contractor. Only a major policy shift by the Soviet Union in the direction of peace and disarmament will significantly lower the Government market.

One contractor summed up the commercial market as follows: The commercial market, on the other hand, with its extreme sensitivity to economic change, is likely to be depressed by any one or more of a number of economic destabilizing events, for example, wars between major powers, economic embargoes, widespread famine, a worldwide recession, runaway inflation,

and collapse of the international monetary system are but a few of the events which might interfere with the development of world air travel and in turn depress the commercial market.

D. MARKET OVERVIEW

One particular contractor expects that the recent resurgence in the aerospace market will continue and in the next 10 years, the market will increase in real value to a level of \$46 billion, growing at an annual average rate of 3.1%. Assessing the marketplace and deciding which avenue to pursue is difficult. Once the decision is made to pursue a particular segment of the aerospace market, heavy facilitization and company commitment is necessary. Keeping a firm competitive, while being able to perform an orderly transition from one market to the next can be a challenge.

1. Industry Attributes

As indicated by contractors interviewed, the aerospace industry is heavily invested in research and development projects along with major investments in facilities. Due to the magnitude of the required capital investments in the industry, there exists significant barriers to entry. These barriers have created an oligopolistic industry which caters to a duopoly customer base. Huge capital investments for production facilities presents the first type of barrier and for the most part is the primary one [Ref. 1: 4]. Facility investments mean depreciation, maintenance, real estate taxes and other fixed overhead costs. Secondly, some companies have within their sphere of business opportunity the ability to

backward integrate. Instead of subcontracting to obtain required assemblies, the manufacturing of the assemblies have been produced in-house. This move toward backward integration has drastically reduced the opportunity for potential suppliers to compete in the business. It not only reduces the potential for new entrants, but it requires additional facilities and manning which drive overhead.

Some aerospace companies must be able to endure a substantial peak liability for a particular aircraft. This is primarily due to the long period of time between the actual blueprints and the first sale of the aerospace product. The contractor may have to withstand years of excess production capacity [Ref. 1: 7].

The aerospace industry has evolved over time from many firms to very few within their respective market segment (oligopoly). There are approximately ten firms involved in the DOD segment and in some instances have diversified into non-aerospace markets. Some contractors are diversifying into data systems as a hedge against a risky military market [Ref. 1: 34].

The aerospace industry represents complex risk situations. The successful companies have attained long term programs to realize benefits from the learning curve [Ref. 12: 1]. The risks are embedded in rapidly changing market conditions, changes in technology, changes in management, and the ability to meet the customers' needs. Corporate success is built upon sound strategy in analyzing the customer, financial

forecasting, market needs, government action, competitive action and staying on the leading edge of technology. For example, timing is a critical aspect: In the 1950's Lockheed produced an airplane called the Electra/Orion and competed against Boeing's 707 for the medium range market. Although in the Orion's early days there were some structural problems, initial delivery to American Airlines in 1958 proved to be technically successful. However, this almost proved a blunder for Lockheed in going head-to-head against Boeing with its innovative jet engined 707. In the commercial application, Orion would have been a failure. Only through the proper investigation of military needs could Lockheed's Orion survive. The Orion came too late with obsolescent technology to compete against Boeing [Ref. 12: 11].

This illustrates the point that aerospace corporations must be cognizant of timing and obsolescence when starting new programs.

2. Capital Investment

The aerospace industry is critically dependent on tremendous investments in fixed assets. As one contractor stated: Assembly is an intense operation and production quantities are small. In many situations, it would not be cost effective to invest in labor saving devices for small production runs. The Hempson study provided some startling information concerning aerospace investments in plant and equipment.

Capital expenditures, both for facilities and tooling, have been large in recent years. While capital spending peaked in 1980 at \$7.0 billion or 13% of total sales, expenditures of \$6.5 billion in 1981 and 1982 (10.7% and 9.8% of sales, respectively) are over three times higher than 1977 figures which represented 6.2% of sales. [Ref. 1: 5]

Investments in facilities place a significant degree of risk on the aerospace corporation. Once investments are made in plant and equipment, the contractor must be able to shoulder the fixed overhead. Even a mild cutback in program funding could significantly affect capacity utilization. Spreading overhead over less programs means increases in overhead rates.

3. Subcontracting

Some aerospace corporations have operated more as assemblers of aircraft components rather than making assemblies in-house in order to reduce the financial burden of investing dollars in additional manufacturing sites but also to reduce exposure to financial risk. One contractor provided data on various aircraft highlighting the degree of subcontracting. Some aircraft experienced subcontracting procurements as high as 65% of the total cost. It is not uncommon to subcontract over half the production effort of a particular aircraft [Ref. 1: 6]. However, as pointed out by the Hempson study, there is a significant increase in the indirect labor associated with coordinating and directing this subcontracting business. Some contractors argue that subcontracting will produce cost savings to the customer due to increased competition between component suppliers. This may be true especially under the multiyear concept in providing long term

contracting for economic quantity orders. But under normal contracting arrangements, ordering on a year to year basis, the potential dollars to be saved could be overshadowed by the indirect overhead associated with the necessary coordinating efforts [Ref. 1: 6].

E. SUMMARY

The aerospace industry is affected by various factors which impact overhead costs in one way or another. Aircraft programs either commercial or Government represent very complex risk situations. The most successful aerospace contractors attain long term programs in order to achieve sufficient production volumes. However this has been made difficult with high inflation, changing market conditions and the requirement for state of the art manufacturing facilities. Due to these aspects there exists significant barriers to entry. Many financial, technological, subcontracting, and market segment decisions, become irreversible and can be very costly. In some cases these strategy decisions commit the company into shouldering long term overhead costs.

The consensus from the researcher's interviewees indicated that if acquisition managers could use the same indicators that contractors use, the ability to identify a potential overhead control problem may be increased. Therefore, Chapter V contains those indicators that are presently being used by various aerospace contractors.

V. MANAGEMENT INDICATORS

A. NEED FOR INDICATORS

Some Government acquisition managers believe that overhead costs are not being effectively controlled. Acquisition managers have a multitude of information to review as part of their monitoring responsibility. For reasons mentioned in Chapter III pertaining to the difficulty in tracing overhead costs coupled with unique aspects associated with the aerospace business environment, the monitoring role of the acquisition manager has been complicated.

One interviewee indicated that a primary task of the Government acquisition manager is to challenge and attempt to influence the contractor regarding overhead costs. However, as discovered during this research, the ability to perform that task may be impeded by several aspects. Rates, for the most part, are computed using relatively complex accounting systems employed by contractors. Overhead forecasting is not an exact science. Aircraft contracts take years to execute and forecasting an accurate business base is difficult. Therefore, the Government acquisition manager needs useful tools or management indicators to evaluate how a particular contractor is controlling overhead costs.

One contractor pointed out that accounting systems and techniques for control differ from one contractor to the next. Control systems are company unique. In order to improve the

acquisition manager's ability to evaluate a contractor's overhead cost control, various interviewees stated that he should use those indicators that a particular contractor uses. However, an indicator is only the beginning of an investigation that may be necessary to identify the factors that cause overhead costs to exceed budget levels.

B. TYPES OF INDICATORS

The researchers have discovered that a series of indicators in the following categories are representative of management indicators that various aerospace contractors use in assessing their overhead cost control: Administrative, variance analysis, base forecasting, comparison of dollar amounts, the comparison of ratios, and a new tool, called Overhead Costs Analysis Package (OHCAP). Each area will be developed including the indicator's intended focus and use.

1. Administrative Indicators

The management of indirect costs requires two basic actions. Those actions are: (1) plan in advance what the total costs should be, and (2) hold the line on those actual costs to the projected level and be able to substantially justify any differences [Ref. 10: 15].

a. Planning, Budgeting and Control System

A proposal to incur overhead costs is prepared by the contractor, negotiated and monitored by the appropriate Government acquisition manager. Part of this monitoring responsibility should concern itself with the

contractor's planning, budgeting and control system, as one contractor indicated. The planning, budgeting and control system can provide valuable indicators to the Government acquisition manager. Because each contractor has unique planning, budgeting and control systems, some indicators may or may not be relevant to all contractors. However, the control system has a significant impact on overhead cost control, according to the contractors interviewed.

One area that contractors indicated is evaluated continually is the planning, budgeting and control system. They evaluate the system's ability to provide timely as well as accurate cost information. The acquisition manager can obtain an assessment of the contractor's overhead cost control by monitoring the way the contractor utilizes information from and the actions taken on overhead cost data. For instance, some contractors utilize a cost containment review board, as part of their planning, budgeting and control system. Their decisions concerning the corporate position on many overhead items can reveal whether the contractor tightly controls costs or tends to be loose in cost management. Even though planning, budgeting and control systems may vary between contractors, the researchers found that the following aspects should be incorporated into an effective system: it should be fairly formal, guidance should be clear and unambiguous in making policy concerning overhead costs, guidance from marketing should be provided in forecasting the business base, and the financial department should exhibit a hands-on

policy in budget formulation and monitoring. Several key indicators were provided by contractors interviewed and are discussed in the following subsections.

b. Decision Points

The first indicator may be found in evaluating where the decision points are in the cost determination process and their effect on a contractor's cost control culture. What the decision points are and who exercises final approval regarding cost decisions within the organization may provide clues as to the corporate culture of overhead control. One contractor explained that they used a cost containment review committee that establishes certain guidelines and policies concerning overhead items. For instance, they set policies as to who can be members in certain clubs or organizations and the level of spending that would be authorized. The committee also sets policy and reviews the company's travel and training budget. Part of this review is to ensure that high priced or extravagant travel expenses are avoided. This cost containment review committee has had a significant impact on corporate overhead costs because the policy has emanated from the highest levels within the organization. This seems to follow the premise stipulated in Chapter III that overhead cost control is an executive responsibility. Therefore, an effective planning, budgeting and control system should indicate to management a sound procedure within the company for preparation, review and approval of overhead costs at the

highest levels (the decision points). This is highlighted by the following:

The first thing to know about the contractor's budget system is who initiates the figures, who reviews them, and who finally approves them. There should be a formal arrangement within the company for budget preparation. [Ref. 10: 23]

The researchers found that an understanding of internal company budgeting may provide insight into overhead control. One report stated that:

A top official in the financial department of the company usually will have responsibility for coordinating the various budget efforts. Upon receipt of the assumptions and guidance, he will issue that information to the department heads and staff directors and call for their budgets. [Ref. 10: 24]

However, the researchers found that the financial department's voice in overhead issues varied between contractors. The indicator may not always be the same. One contractor used the financial department to provide information to the cost containment board for further investigation. For another contractor, the financial department was overseer of the operating budget and was primarily interested in the total budget authority delegated to divisional levels. The quality of a planning, budgeting and control system is dependent on people and how well they are organized and supervised to do their particular job, said one contractor. The company should be able to demonstrate that its organization provides the checks and balances that will promote objectivity and realism in the budget planning.

c. Computing Business Base

Another administrative indicator pertains to an assessment on how the contractor computes his projected business volume. The system employed must reflect a sound method for forecasting sales and evidence that a reasonable base has been derived from the projected sales figures [Ref. 10: 25]. The base is usually a function of the direct labor hours or dollars used by the contractor.

Previously it was noted from research that this base has grown more slowly in some instances than have total overhead costs.

Direct labor costs may grow more slowly than other costs or even decline because of changes in technology (e.g., more automation or production operations) and/or changes in production agreements (e.g., more subcontracting). While such changes will cause the overhead rate to increase, they will not cause total costs to increase. For example, automation could reduce direct labor costs by more than the attendant increase in overhead costs. While concern about overhead costs, per se, is still appropriate, it should not cause managers or customers to lose sight of the pattern of total costs. Overtime, direct labor cost may not be a good basis for studying trends in production volume if there is evidence that the proportion of direct labor to total costs is changing. Perhaps total cost input would be a better measure of overall activity. Sales revenue might also be a useful measure here, although trends may be affected by the choice of accounting method. [Ref. 4: 17]

The researchers found that becoming very familiar with the contractor's system in forecasting the business base to be a critical aspect in the monitoring role. An effective planning, budgeting and control system can aid the acquisition manager in assessing base forecasts. For instance, if a particular contractor is projecting a significant

change in the business base, such as a drastic increase, indicators could be tailored to monitor the contractor on a case-by-case basis. The management indicator would be a relationship between indirect staffing to total personnel. An increase in the business base should not necessarily command a large manning increase in departments such as the personnel department, accounting department, or the contracts department, said one contractor. Just because business volume is projected to increase, a commensurate increase in overhead manning may not be warranted. Some example mentioned as useful to various contractors are represented by the following relationships:

- (1)
$$\frac{\text{total people in material handling}}{\text{total personnel in company}}$$
- (2)
$$\frac{\text{total people in contracts department}}{\text{total personnel in company}}$$
- (3)
$$\frac{\text{total people in accounting department}}{\text{total personnel in company}}$$

These relationships can be useful to the acquisition manager in assessing reasonableness because they highlight potential growth trends that may or may not be acceptable at a particular volume. Therefore, the planning, budgeting and control system should provide for continuous reviews by the company of its functional organization.

d. Functional Organizations

According to one contractor the planning, budgeting and control system should provide an assessment of the company's functional staffing. One contractor pointed out that the system should provide management with a warning that identifies functions that may be overstaffed. Some functions may have been established during periods when the volume differed significantly from that currently in effect. One contractor receives reports on a weekly basis identifying indirect manning throughout the organization. He uses the report as a management tool to monitor these overhead activities.

The manner in which a particular contractor reviews and decides on overhead staffing in times of a fluctuating business base provides one administrative indicator. One contractor pointed out that during a projected slowdown, those people in the overhead functions were the first to be released or furloughed. The use of the indirect staffing reports can provide the contractor with timely information.

e. Forecasting Indirect Costs

The researchers found that indirect costs associated with people-related functions constitute the major cost driver of overhead. The planning, budgeting and control system should provide an indication as to how the contractor arrives at the proper headcount to conduct business. A detailed analysis of the particular tasks to be performed may provide justification for personnel levels. One contractor

said they use engineering estimating techniques to compute reasonable manpower requirements for many direct and indirect staffing decisions. However, one contractor said their system does not lend itself to some indirect categories, such as corporate executives and high salaried positions, because the establishment of these positions are not a function of the business base.

Some costs will vary proportionally with direct labor. An example would be manufacturing supplies which increase with the number of direct labor hours involved. Another method of verifying indirect cost projections is to make comparisons between previously incurred costs, either in dollars or as a percentage of the base figure. One contractor said he used various reports from his planning, budgeting and control system which highlighted certain cost accounts that are projected to exceed previously incurred costs by a significant amount. These reports provided him with an indication that a problem may or may not exist. Sometimes, an in-depth review must be accomplished in order to ascertain whether or not that particular cost account is projected at an unreasonable level.

f. Budget Formulation and Execution Phase

The researchers found through interviews with both DOD and contractor personnel that the planning, budgeting and control system should incorporate key factors if effective overhead cost control is to be exercised.

The budget system employed by the contractor should be composed of five distinct and separate phases: The budget call, budget submission from organizational segments, a negotiation phase, a senior management review phase and the performance measurement phase.

The researchers found that the budget call should be dictated by corporate policy identifying specific guidelines, including ground rules and necessary assumptions to be used in forming the corporate budget. One contractor said that cost control policy and guidance should originate from top management. The guidelines and policy should be contained in the budget call. The budget call will indicate corporate philosophy pertaining to cost control. Another contractor stated that during the response phase, the financial management staff will try to identify budget requests that may be unreasonable.

Indirect manpower requirements should be based on the zero base budgeting concept, suggested one contractor. Justification for all personnel is important and should be based upon a clear delineation of tasks to be performed. Justification should not be predicated merely on an increase in the business base, as was pointed out earlier. Contractors use the response phase as a tool to identify potential overhead growth problems.

Upon receipt of the budget estimates from the operating divisions, the researchers found that a concurrent estimation is made by the financial management staff. One

contractor indicated that the negotiation phase of budget formulation and approval is perhaps the most intense phase. The contractor went on to say that this is where the cost containment philosophy prevails and two areas are scrutinized. One is the business base which consists of people, hour and dollar projections, and the other is the associated overhead which includes all indirect labor costs and non-salaried employees. Approval of the budget sets the stage for performance and execution.

The performance and execution phase will enable the acquisition manager to monitor the status of direct and indirect staffing. One contractor uses variance analysis on total plant-wide indirect costs as a tool to monitor overhead cost control. The researchers found that variance analysis is a valuable tool that contractors use in monitoring overhead costs and will be discussed in detail later in this study.

g. Performance Reports

The usefulness of indicators is increased if the contractor's system provides data reporting actual versus budgeted dollars. The following areas were indicative of the data that various contractors analyze:

- (1) Direct staffing
- (2) Indirect staffing
- (3) Overtime/premium
- (4) Labor rates (base, premium and non-work)
- (5) Salary dollars (worked and non-work)
- (6) Non-salary expense dollars by account

- (7) Overhead pool visibility by organization
- (8) Investment tracking system

Additionally, the researchers found that asking the following questions may provide the acquisition manager with an indication as to the contractor's overhead cost philosophy:

- (1) How frequently does senior management review reports?
- (2) How are staffing levels decided?
- (3) What do the organizations do with the performance reports?
- (4) Who reviews the variance reports and what actions are taken by Management?
- (5) Are managers held accountable for their budget?
- (6) Are individuals evaluated on how well they execute their budgets?

The researchers found that the answers to these questions may indicate to management where weaknesses prevail. For instance, when one hardly notices a challenge or questioning on the part of the contractor for hiring additional personnel, one may need to evaluate the justification for additional hiring. If the company does not have tight hiring practices, it may be necessary for the acquisition manager to investigate and assess those hiring policies against corporate volume forecast. This example was presented by a contractor interviewee to illustrate that an effective planning, budgeting and control system will alert management to potential overhead problems.

The researchers found that the acquisition manager may have differing philosophies in ascertaining how many and in what order of priority management indicators can be used to better monitor overhead costs. The decision to use one type of indicator over another may be a function of how confident the acquisition manager is concerning the contractor's overhead control culture. One contractor indicated that he preferred to use headcount comparisons between indirect staffing and direct staffing. He used this tool to monitor the workforce mix. Some preferred headcount indicators while others preferred to compare previously incurred costs. One contractor preferred to use flexible budgets as a tool to monitor overhead costs.

h. Flexible Budgets

The basic premise of a flexible budget is that for any given volume of business there should be a commensurate expenditure level. That level should be known beforehand in order to provide a guide to actual expenditures. The flexible budget provides management with information necessary to achieve the objectives of budgetary control [Ref. 9: 527].

These objectives are to provide management with: 1) An organized procedure for planning, 2) A means for coordinating the activities of the various divisions of a business, 3) A basis for control. [Ref. 9: 528]

The researchers found that budgeted costs are appropriate for all bases which are derived from sales volume and plant workload [Ref. 10: 30]. The flexible budget is

one which contains a methodology for increasing or decreasing the indirect cost goals (which were budgeted against estimated bases) to goals which are appropriate for the actual bases [Ref. 10: 30]. The use of flexible budgeting may not be appropriate in all cases due to the non-linearity of some overhead costs, but the technique aids in the identification of potential overhead control problems [Ref. 10: 31]. Flexible budgets provide a planning tool for the contractor to monitor overhead costs. One contractor indicated that he used flexible budgeting to highlight potential overhead problems during execution of the budget.

The accepted technique for establishing and using a flexible budget is expressed by the equation for a straight line [Ref. 10: 30]. For example:

$$Y = a + bX$$

where:

Y = Indirect cost dollars expected at base value (X)

a = Dollars of fixed indirect costs (do not vary with volume)

b = Variable indirect cost per unit of the base

X = Base in units. [Ref. 10: 31]

The values for a and b can be determined by specifically identifying the amount of fixed costs, costs that do not vary with volume (a), and expressing the remaining

portion of the variable costs as a percentage of the base (b). The following hypothetical example is provided as an illustration of the use of flexible budgeting for a fictitious manufacturing overhead pool. It is assumed that the following budget has been established by detailed analysis of all indirect costs that are applicable to a direct labor base of \$15 million direct labor dollars.

Base in direct labor dollars (X)	=	\$15.0 M
Total indirect costs (Y)	=	\$19.5 M
Fixed indirect costs (a)	=	\$ 7.5 M
Variable indirect costs (Y-a)	=	(\$19.5 - \$7.5)
	=	\$12.0 M

$$\begin{aligned}
 \text{Variable indirect costs per unit of base (b)} &= \frac{\text{Variable Direct Costs}}{\text{Base Direct Labor Dollars}} \\
 &= \frac{\$12.0}{\$15.0} = 0.8
 \end{aligned}$$

A flexible budget can be constructed at many levels of volume. In order to determine what the indirect cost budget should be at an input base of \$10.0 M using the same equation, one obtains an estimated overhead figure of:

$$Y_1 = \$7.5\text{M} + 0.8(\$10.0\text{M}) = \$15.5 \text{ M}$$

Likewise, a separate budget can be computed at a base of \$20.0 million. The equation indicates that indirect costs should approximate the following:

$$Y_2 = \$7.5\text{M} + .80(\$20.0\text{M}) = \$23.5 \text{ M}$$

Figure 5.1 highlights the nature of the flexible budget. In plotting the straight line for the points Y_1 and Y_2 , extension of the line back through the y axis (y intercept) produces a level of fixed costs that are reasonably close in the relevant range. "When statistical techniques are used, projections outside the range of observations may not be valid" [Ref. 10: 23]. This represents the management line at various base levels. For each \$2.5 million change in the direct labor base, we notice that indirect costs vary by \$2 million. The variation is due to fluctuations in volume of 80 percent. This relationship is:

$$\frac{\text{Change in total indirect costs}}{\text{Change in total direct labor dollars}} = \frac{Y}{X}$$

This indicator provides the acquisition manager with a forecasting tool. However, some indirect costs do not always vary with fluctuations in volume [Ref. 10: 33]. Some changes will be slow and others will move in distinct steps which are not linearly related. One contractor indicated that some indirect staffing decisions are not necessarily related to volume. However, the use of the straight line technique is useful to highlight potential overhead control problems [Ref. 10: 33]. Fluctuations beyond a reasonable percentage of budgeted volume may require the calculation of a new budget rather than use of the original one. During a one year budget cycle, such wide fluctuations would be rare [Ref. 10: 33]. The reliability of the flexible budget is

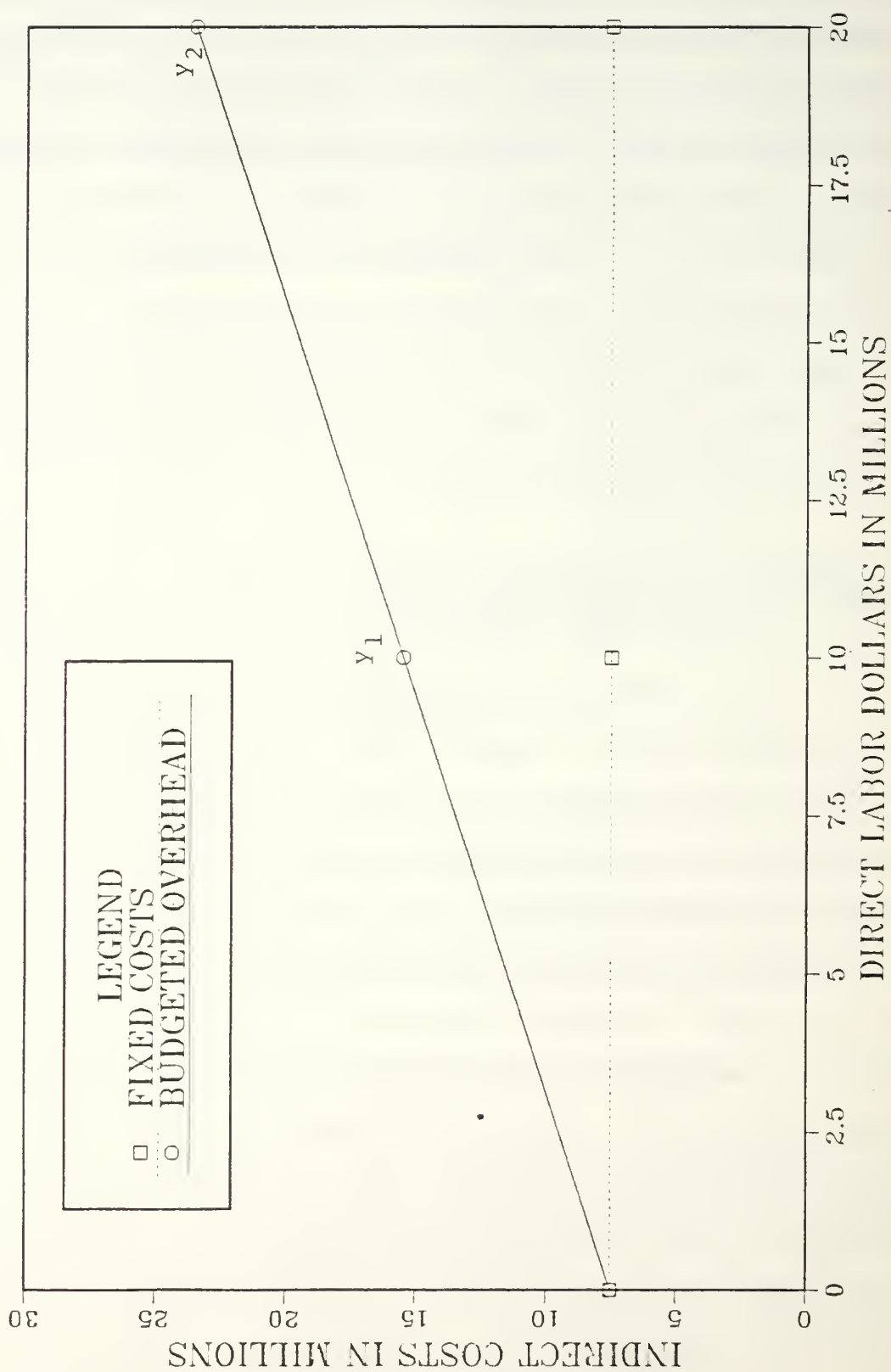


Figure 5.1 INDIRECT COSTS VERSUS DIRECT LABOR DOLLARS

dependent upon the accuracy of forecasting that has gone into the cost estimates. The researchers have found that contractors use industrial engineering estimates to forecast appropriate overhead levels. The engineers provide these forecasts based on historical experience and various cost estimating techniques. Some of these techniques include statistical techniques and regression analysis.

i. Industrial Engineering Analysis

Industrial engineering analysis can be used as a valuable planning tool, indicated one contractor. Utilization of the industrial engineering staff in order to form an assessment as to the reasonableness of costs, and the assumptions that have gone into cost determination, can become valuable to the acquisition manager because the individual engineers try to answer the following questions:

1. Why is the function being performed? Who asked for the overhead service? Who uses it? Are they aware of the cost of this service? Is the service essential? Is the function related to a sound goal?
2. How is the function being performed? Has any recent analysis been made of the method? Is the method used to perform the task sound? Have the impacts of more cost effective methods been discussed with the performers or users of the service? What are the limitations or changes in the performance method?
3. How efficiently is the operator performing the function? Alternatively, how effectively is the operator achieving the purpose of the function?

The researchers found that an exhaustive analysis is performed by various contractors in answering these questions. These questions are important from an output point

of view because the answers to these questions provide the acquisition manager with justification for the function, current operations of the function, and how efficiently the function is being performed.

Many overhead functions evolve or get established due to a perceived need for certain services, stated one acquisition manager. Some may be categorized as nice to have and these will require significant attention on the part of the acquisition manager [Ref. 10: 73]. Engineers normally approach the users of such overhead functions to ascertain the necessity of the function. For instance, one contractor explained that a standard technique to assess information utility is to ask the recipient of computer reports what he does with those reports. Engineering analysis can provide an assessment of the necessity for a particular function and provide the acquisition manager with some clues [Ref. 10: 73]. As an example, a supply clerk may issue one part to the fabrication department on one document whereas he could issue small common items from an already expended bin with no documentation. Reductions in documentation, waiting time or servicing time can be accomplished through a methods study. A methods study usually performed by industrial engineers can target activities or functions that are being performed in inefficient ways. Contractors use the industrial engineer's analysis as a tool to identify areas or functions that are either not necessary, not effective or not efficient.

Establishing a sound method for performing an indirect function will determine to a large degree whether or not the cost of the function is reasonable [Ref. 10: 74]. It was evident from the interviews that industrial engineers can provide a valuable appraisal as to the function's efficiency. Usually the efficiency can best be expressed as a relationship between input and output. The output from many activities cannot be quantified in a feasible fashion. However, in most cases, effectiveness can usually be determined.

Identifying potential problem areas in overhead either through observation, flexible budgeting, or company identification, can be supplemented by using the industrial engineer's analysis. The researchers found that his analysis will usually include the following assessment:

(1) Performance Measurement. This is particularly useful where the outputs can be quantified and engineering standards applied. The ratio of resources employed in relation to the output obtained will provide evidence as to a function's efficiency [Ref. 10: 76].

(2) Goal Achievement. This could be useful for those activities not generating quantifiable output. Engineering standards are objective standards whereas goal achievement standards are very subjective. However, the mere existence of standards in a performance system compliments the usual historical data comparison technique in evaluating the budgeted costs [Ref. 10: 77].

During the data collection phase of this research, it became obvious that areas of opportunity to explore and investigate would lend themselves to exhaustive industrial engineering analysis in order to assess reasonableness. One such area concerns the rapidly growing computer services divisions within some aerospace corporations. The engineering estimates and forecasts provided in this area could reveal or indicate to management the level of reasonableness of services provided. Techniques such as standard data systems, predetermined time standards or work sampling methods may be used to evaluate these high cost functions. Engineering forecasts and analysis can provide insight into the actual functioning of the computer services division and assess the division's necessity and the methods and reporting system that are employed.

Up to this point the researchers have identified various administrative indicators, many of which are found in the contractor's planning, budgeting and control system. In fact, for some the system provides performance reports and analysis in these areas. It was evident to the researchers that some contractors use their planning, budgeting and control system as a management information system. The various indicators contained in this section provide clues in assessing the corporate cost control culture, clues in forecasting indirect costs and clues that industrial engineering analysis may provide management. These indicators are reflective of

the exhaustive review that an acquisition manager may have to accomplish before he can assess overhead cost control within a contractor's plant.

2. Variance Analysis

As one contractor put it, monitoring performance is the key to overhead cost control. Management has a chore to ensure that the actual costs follow the budgeted forecasts. The acquisition manager has at his disposal a valuable tool to use in carrying out this monitoring role. This tool is variance analysis.

Actual costs are evaluated against budgeted costs. Variance analysis may or may not be part of the contractor's monitoring system. But if it is, the variance analysis will identify differences between actual and budgeted costs. The following example highlights the use of variance analysis.

Many contractors apply overhead to work in process at a uniform rate by dividing the budgeted indirect costs by the estimated base. "Applied costs at the end of the year (before adjustment) will be the product of the overhead billing rate times the actual incurred units of the base" [Ref. 10: 82]. If it is determined that the budgeted indirect costs should equal \$19.5 million with an anticipated base figure of \$15 million direct labor dollars, an overhead billing rate is computed to be 130% (Budgeted Indirect Costs/Indirect Labor Dollars). Variance analysis identifies two types of variances. One is the volume variance which is caused by the actual base factor being greater or less than budgeted. The second is

the spending variance where the actual indirect costs differ from budgeted costs. The end of the year difference between the actual indirect costs and the applied (billed) indirect costs is the variance. The variance tells the acquisition manager that the indirect costs have either overrun or under-run the budget.

The volume variance is a result of a change in the actual base from the projected base. In this hypothetical case, the budgeted overhead billing rate is 130%. Assume in this example that the actual direct labor volume for the year totals \$13.0 M. Overhead has been applied at 130% of direct labor for a total of \$16.9 M. The budget goal for a direct labor volume of \$13.0 M is \$17.9 M in indirect costs. The difference (\$1.0 M) between the adjusted budget (\$17.9 M) and the costs applied (\$16.9 M) to the actual base (\$13.0 M) is a volume variance.

The volume variance (\$1.0 M) is identified as follows:

Base-Direct labor dollars (X)	=	\$15.0 M	
Total indirect costs (Y)	=	\$19.5 M	
Fixed indirect costs (a)	=	\$ 7.5 M	
Variable indirect cost (Y-a)	=	\$19.5 - \$7.5 = \$12.0 M	
Variable indirect costs per unit of base (b)	=	\$12.0 M/\$15.0 M = 0.80	
Budgeted (\$15.0 M) base indirect costs	=	\$13.0 M (130%) = \$16.9 M	

Actual (\$13.0 M) base = \$7.5M + .80(\$13.0M) = \$17.9 M
indirect costs

VARIANCE < 1.0 M >

A spending variance is the difference between the actual costs and budgeted costs. In the flexible budget system, the spending variance is the difference between actual costs and the budget cost goal to actual volume. If the indirect costs totalled \$17.9 M at a \$13.0 M direct labor base there would be a volume variance and no spending variance.

If the total indirect costs equaled \$23.0 M, a spending variance of \$5.1 M is computed for the \$13.0 M indirect cost goal level. The actual overhead rate to be applied would be 176.15% (\$23.0 M/\$13.0 M). However, the total variance to be considered consists of an overrun of \$6.1 M (\$23.0 M actual - \$16.9 M budgeted), \$1.0 M which is attributed to the variation in the volume being less than planned and \$5.1 M to spending more in the overhead than was expected at the \$13.0 M indirect cost goal. Variance analysis provides an indication to management that corrective action may be required.

The initial result of variance analysis is a determination of the extent to which each of these factors (volume and spending) caused actual indirect costs to overrun or underrun the budget, i.e., to be different than billed costs. [Ref. 10: 83]

During a normal year, one would not expect volume to vary considerably [Ref. 10: 86]. However, one contractor indicated that the major contributing factor affecting volume

could be the result of program termination. When this occurs, and the base affected, the researchers found that the acquisition manager must work closely with the contractor in re-evaluating all projected overhead costs. For instance, those staff functions designated as fixed overhead budgeted at the old volume level in the flexible budget may have to be reclassified or in some cases reduced due to the substantial drop in volume. If particular pool's variance becomes increasingly unfavorable, the acquisition manager may need to work closely with the contractor in determining the cause. The researchers found that the faster the manager can obtain the actual figures, the quicker the unfavorable trends can be identified. The researchers noticed that this is particularly important when the cost base is reimbursable to the contractor.

An analysis of the spending variance includes a review of all the contributing costs. Those overhead costs considered fixed should not be expected to deviate significantly from the budgeted amounts due primarily to their fixed nature. However, when the volume is reduced below the planned level, logic would follow that one should expect variable costs to be reduced. In discussing this process with various contractors, the researchers found that they prefer to avoid significant layoffs of personnel. Thus management may postpone corrective action predicated on an improved outlook. On the other hand, what effect does a potential increase in volume have on the overhead rate? The tightness or rigidity

in hiring may be relaxed. One may notice that the use of the engineering analysis may not be used quite so rigidly. And if the volume falls short of these optimistic forecasts, some increases in staff functions may become unreasonable.

Correction of an unfavorable spending variance rests with the line manager. The variance is an indication that costs have exceeded expected levels. The acquisition manager has no hands-on control of the corporate operation but through use of variance analysis techniques, he can locate specific areas which show unfavorable spending trends. Challenging the contractor on these areas and obtaining corrective action is an essential element in the monitoring role. However, it is still management's responsibility to control overhead costs because:

The goal of department heads and supervisors at lower tiers of the organization is to minimize unfavorable variances in their respective control areas. Hence a line supervisor should receive performance reports on labor and other significant costs at least weekly; daily labor reports might be justified in some instances. Prompt information will enable the supervisor to detect the occurrence of a variance early enough to correct a cost overrun that otherwise might become irreversible. [Ref. 10: 86]

"Review of overhead reports would be expected to lead you and company management to the same conclusions" [Ref. 10: 89]. For instance, when the reports reveal an increasing or unfavorable volume variance caused by a decreasing base, individual items may need to be scrutinized [Ref. 10: 89].

The researchers found that the following kinds of data should be available for inspection on a continuous basis.

- a. Base units in projecting volume for each overhead pool with trend data for the past five years and projections to the end of the current year.
- b. Chart of overhead rates for each pool with projections to the end of the current year.
- c. Variance analysis and areas that require correction.
- d. Special situations such as significant variances or important trends. [Ref. 10: 90]

Figure 5.2 is a hypothetical set of data that is representative of historical data and provides a forecast of manufacturing overhead for 1984. The base is expressed in direct labor hours (DLH), and the figure includes the actual manufacturing, as well as the overhead rate per direct labor hour for each year. Figures 5.3, 5.4, and 5.5 graphically portray the data contained in Figure 5.2. They show the activity of the direct labor hours, manufacturing overhead in dollars and the overhead rates per direct labor hour respectively. The researchers found that some contractors use exhibits similar to these in order to highlight changes in direction over the years. They identify trends in base hours, dollars, and rates per direct labor hours.

Using the forecast contained in Figure 5.2, a pool budget for 1984 can be constructed. Figure 5.6 identifies how many hours will be expended per quarter (engineering estimates). Then the total manufacturing overhead forecast

<u>Historical Data Base</u>	<u>DLH (millions) Base</u>	<u>Manufacturing Overhead (mill. of \$)</u>	<u>Overhead Rate per DLH</u>
ACTUAL			
1974	10.20	53.00	5.20
1975	12.00	57.15	4.76
1976	12.10	70.10	5.80
1977	15.10	89.20	5.91
1978	16.10	91.10	5.66
1979	17.15	94.30	5.50
1980	18.25	96.00	5.26
1981	16.50	91.50	5.55
1982	13.40	81.10	6.05
1983	12.10	80.10	6.62
FORECAST			
1984	11.00	78.00	7.09

Figure 5.2 HISTORY AND FORECAST

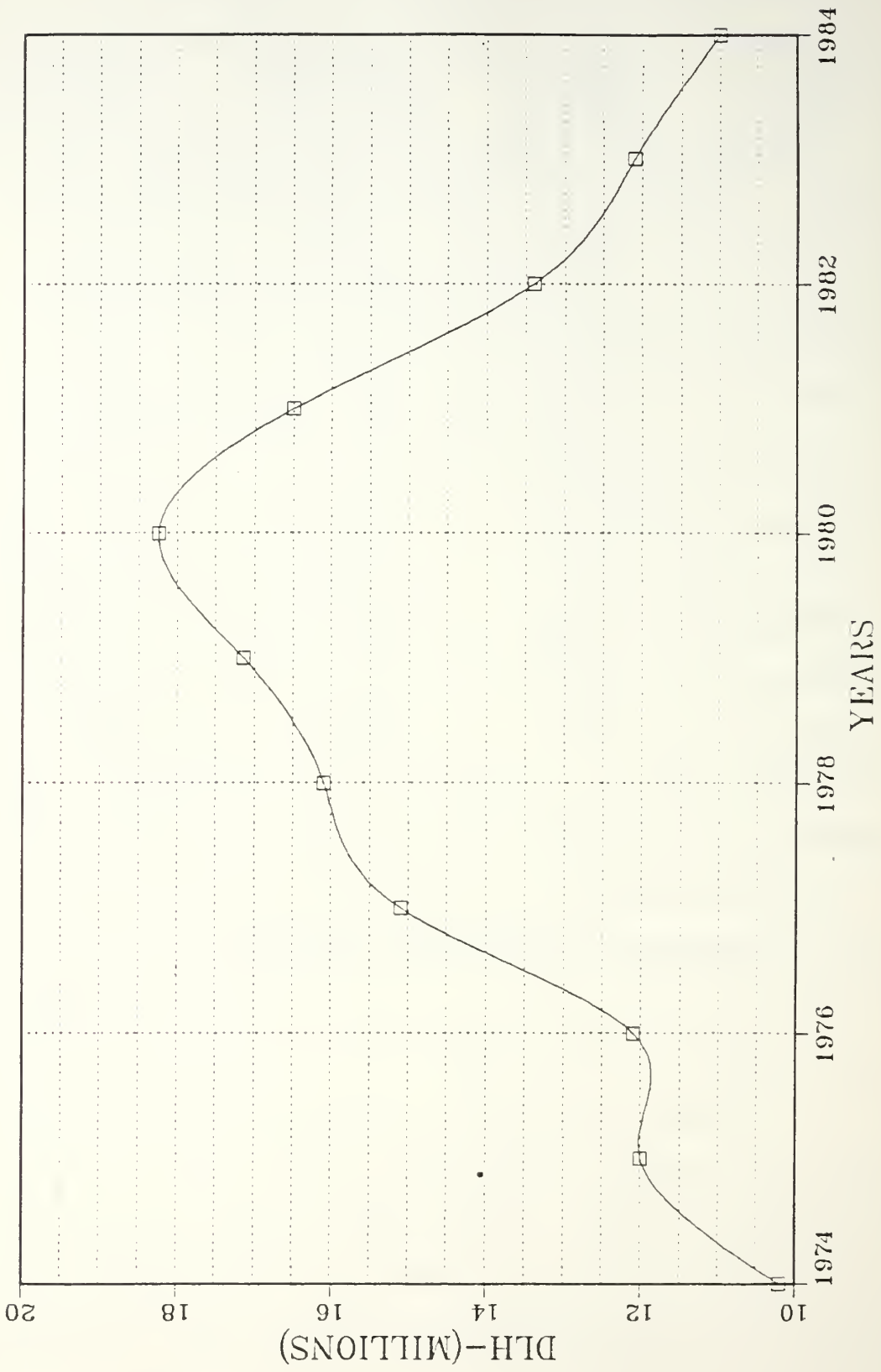


Figure 5.3 DIRECT LABOR HOURS

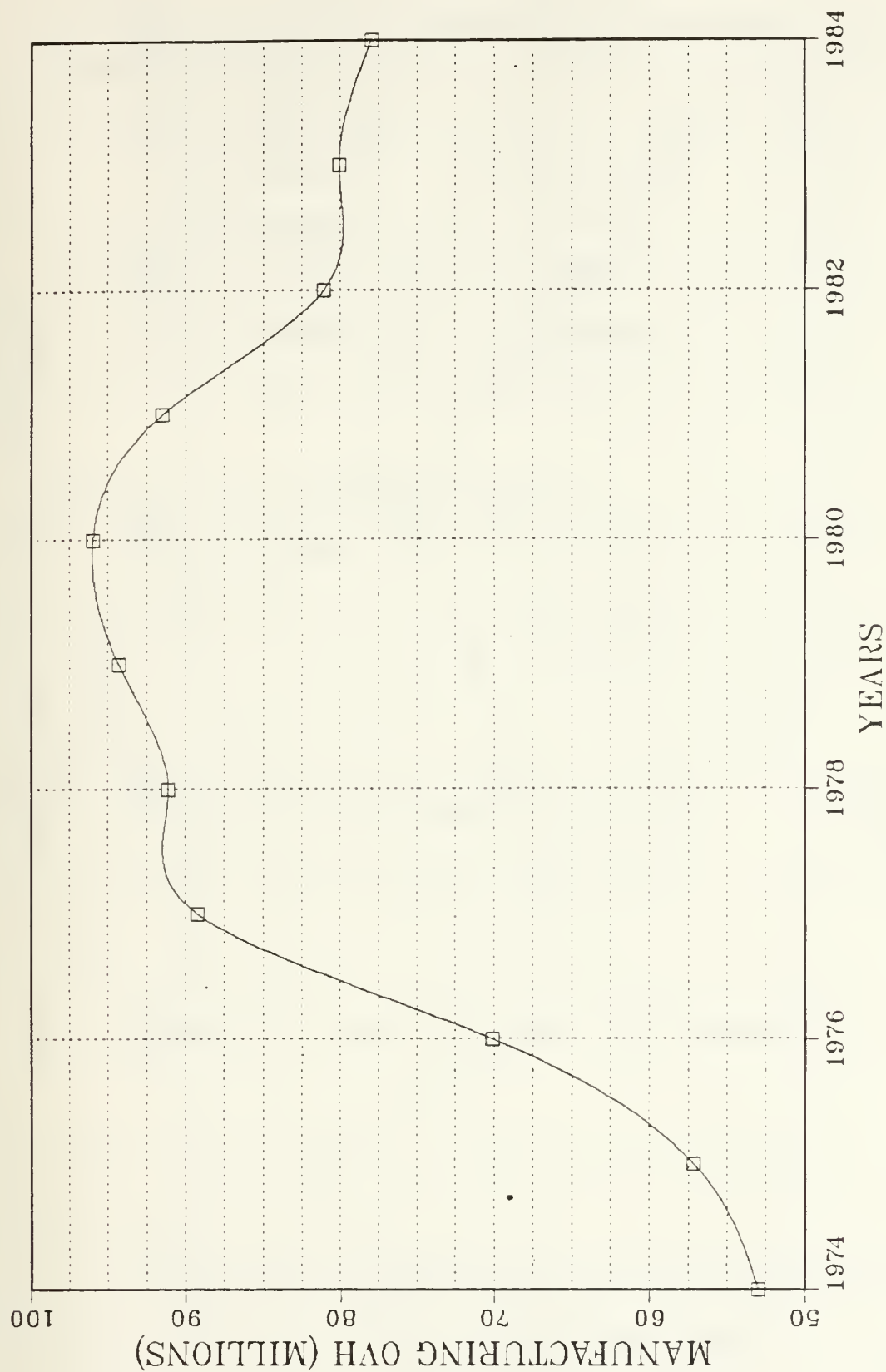


Figure 5.4 MANUFACTURING OVERHEAD IN DOLLARS

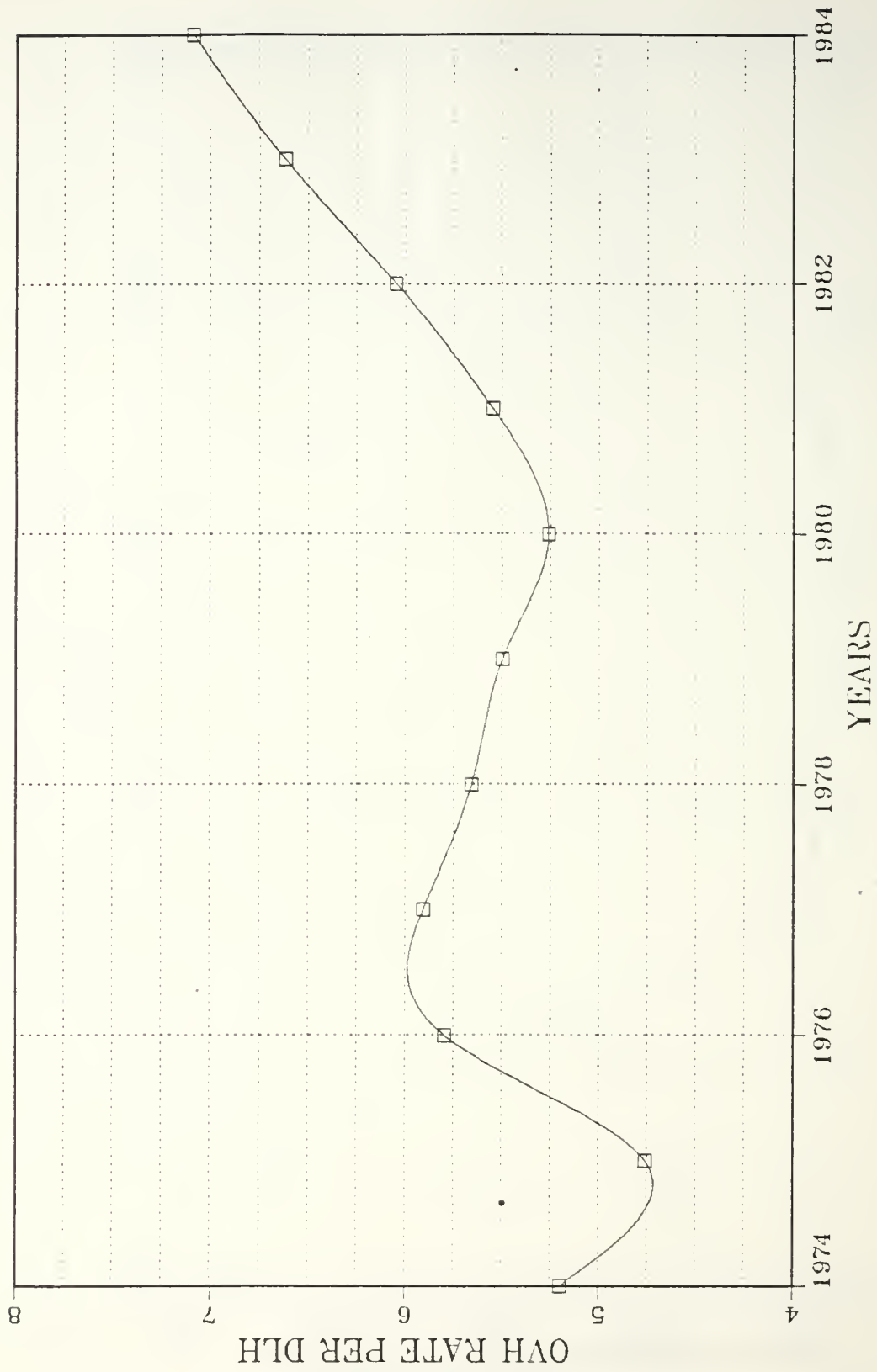


Figure 5.5 OVERHEAD RATE PER DIRECT LABOR HOUR

Forecasted 1984

Direct labor hours

1st quarter	2,000,000
2nd quarter	2,750,000
3rd quarter	3,000,000
4th quarter	<u>3,250,000</u>
Year	11,000,000

Manufacturing Overhead Forecasted

Variable costs	\$ 39,000,000
Fixed costs	\$ <u>39,000,000</u>
	\$ 78,000,000

Rates:

Overhead rate per direct labor hour	\$7.09
Variable rate per direct labor hour	\$3.55

Figure 5.6 DIRECT LABOR AND RATE FORECAST

is made highlighting both variable and fixed costs for that particular pool. The rates per direct labor hour are computed. The manufacturing overhead budget is contained in Figure 5.7.

Utilizing the flexible budget formula (straight line equation), the acquisition manager can forecast the budget levels for the different quarterly base figures. Fixed costs are to be spread evenly over the four quarters, because they do not vary with volume. This provides for \$9.75 million per quarter ($\$39.0 \text{ M} / 4 \text{ quarters}$). The computation section of Figure 5.7 contains the use of the straight line equation to forecast the quarterly indirect costs.

Utilizing the projected budget for the manufacturing overhead pool, one can construct a table highlighting performance as the budget is executed. As the year progresses, adjustments may be necessary. The use of this tool will identify when the overhead rate is being under or over applied. The information in Table III highlights an adjusted budget with projected variances for the year. Based on the actual costs to mid-year, management may make a reappraisal of the cost estimates.

The manufacturing overhead pool is projected to show a .16 cent per direct labor hour under application of overhead. This means that recorded costs have exceeded or will, in this case, exceed the budgeted costs. Likewise, if the resultant variance was an overapplication, the manufacturing overhead

	<u>Direct Labor Hours In Millions</u>	<u>Budgeted Manufacturing Overhead In Millions of Dollars</u>
1st quarter	2.0	\$ 16.85
2nd quarter	<u>2.75</u>	\$ <u>19.51</u>
Half year	4.75	\$ 36.36
3rd quarter	<u>3.00</u>	\$ <u>20.40</u>
3/4 of year	7.75	\$ 56.76
4th quarter	<u>3.25</u>	\$ <u>21.24</u>
Year Total	11.0	\$ 78.00

FLEXIBLE BUDGET COMPUTATIONS

$$\text{Quarter 1} \quad Y = \$9.75 + \$3.55 (2.0) = \$16.85$$

$$\text{Quarter 2} \quad Y = \$9.75 + \$3.55 (2.75) = \$19.51$$

$$\text{Quarter 3} \quad Y = \$9.75 + \$3.55 (3.0) = \$20.40$$

$$\text{Quarter 4} \quad Y = \$9.75 + \$3.55 (3.25) = \$21.24$$

Figure 5.7 BUDGETED MANUFACTURING OVERHEAD

TABLE III

MANUFACTURING OVERHEAD PERFORMANCE 1984

	Direct Labor Hours	Flexible Budget Manufact. OVH In mill. of \$	Initial Budget Manufact. OVH In mill. of \$	Volume Variance In mill. of \$	Actual + Projected OVH	Spending Variance In mill. of \$
Actual						
1st qtr:	2.0	16.85	16.85	-0-	17.00	.15
2nd qtr:	<u>2.95</u>	<u>20.22</u>	<u>19.51</u>	<u><.71></u>	<u>21.10</u>	<u>.88</u>
half yr:	4.95	37.07	36.36	<.71>	38.10	1.03
Projected						
3rd qtr:	<u>3.50</u>	<u>22.17</u>	<u>20.40</u>	<u><1.77></u>	<u>22.00</u>	<u><.17></u>
3/4 yr:	8.45	59.24	56.76	<2.48>	60.10	.86
4th qtr:	<u>3.25</u>	<u>21.29</u>	<u>21.24</u>	<u><.05></u>	<u>21.00</u>	<u><.29></u>
Year:	11.70	80.53	78.00	<2.53>	81.10	.57

Projected overhead rate/DLH = 81.10/11.70 = 6.93

Budgeted rate/DLH = 78.00/11.0 = 7.09

Variance - underrun per direct labor hour = .16

pool would be charged with more than the actual amount incurred. Proper treatment or recommendation of the variance can be made by uncovering the reasons for its existence.

Variances have been described as favorable when costs have been overapplied and unfavorable when costs are underapplied. The fixed costs are not responsive to changes in volume and remain constant. That is why fixed costs are equally distributed per quarter. Consistency in the total amount of cost means variations in unit costs as volume changes. Therefore, variances result from an interplay of two factors: (1) the volume of production attained, and (2) the resultant expenditures which are made and recorded in a particular period. Variances occur because production has exceeded or fallen below some anticipated capacity and variances occur due to expenditures that differ from budgeted allowances.

Interim variances during the year may merit significant attention on the part of the acquisition manager. As a result of seasonal differences in the volume of production, favorable and unfavorable variances may be normal. It is unlikely that a particular contractor will operate at a predetermined capacity or expenditure level. Therefore, the acquisition manager may need to identify the origin of the potential problem. To do this, he may need to ask the following questions:

- (1) Was the base used in calculating the application rate erroneous or not realistic?
- (2) Is the contractor maintaining excess capacity?

- (3) Were budget estimates in error?
- (4) Are the differences between the expected costs and the actual costs due to controllable efficiency factors in the utilization of capacity or the purchase and consumption of supplies?

More important than what did happen is what should have happened. When performance is deviating from expectations, variance analysis aids in the identification of potential problems. Further analysis may be necessary to identify if the variances in spending are due to changes in prices not anticipated or as the result of waste.

The purpose of variance analysis is to identify the causes of indirect cost overruns in order that corrective action can be taken. In order to do that each variance must be identified to the specific cost centers.

3. Determining A Reasonable Base

The contractor translates sales volume into a production plan primarily through the use of engineering estimates. The plan includes the computation of the in-plant workload, after taking into consideration such matters as economic production quantities, level schedules, inventories, make or buy strategy, and stability of personnel. For these, the engineer will require detailed sales estimates which identify specific products and delivery schedules.

The major task in determining the in-plant workload is predicated on estimating direct labor for the major projects. On a multitude of smaller sales, the computation of the base may be statistical, and may be based on a relationship of labor to sales in previous years [Ref. 10: 57].

The complexity of the indirect cost budget submissions is a direct function of the large number of burden centers associated with the particular pool. The acquisition manager may need to ensure that a reasonable allocation between Government contracts and other work is attained.

In the previous example, direct labor hours were used as the base for manufacturing overhead. For the most part, indirect manufacturing costs are caused by the incurrence of direct labor. This pool usually consists of supervision, indirect labor, labor-related expenses (work and nonwork), supplies, and fixed overhead.

The acquisition manager may need to analyze the reasonableness of a base. For example, some types of material are significantly more costly than other material, but cost the same to handle. This provides an indicator to management that if the higher priced material is used for only one type of work, the use of un-weighted dollars as a base would be unreasonable. The use of a separate burden pool to capture these costs may be necessary for the handling of the higher priced material. However, certain types of overhead, such as utility costs, are usually based on floor space and maintenance charges based on machine hours [Ref. 10: 51].

Planning will avoid sudden changes to personnel requirements and other expenses. In order to arrive at reasonable sales forecasts one can get an indication of reasonableness by assessing how the contractor arrives at the sales figures.

One acquisition manager indicated that he monitors the contractor's win/lose record on contract awards. If the contractor projected the sales figures with a high degree of success, his procedures and methods in computing sales may be considered reasonable.

C. OTHER INDICATORS

The researchers found that contractors may use other tools to monitor overhead costs. One approach that seems to be a widely used method is comparative analysis. Some acquisition managers use comparative analysis as a management tool in assessing reasonableness. The techniques can be illustrated by the hypothetical question, "You spent X dollars last year. Why do you predict it will cost X plus 10% next year?" [Ref. 10: 60]. A Logistics Management Institute study concluded that many indirect functions do not change significantly from year-to-year. The historical cost, properly adjusted, can be a sound basis for projecting the future cost. "However, your job is to do more than forecast 'will cost,' you also must strive for 'should cost'" [Ref. 10: 60]. Effective comparative analysis is dependent on the assumption that costs of the base year were reasonable.

Once determined reasonable, comparisons are normally made in two ways: through comparisons of dollar amounts and through comparisons of the ratios of the cost to acceptable variables. [Ref. 10: 61]

1. Comparison of Dollar Amounts

Some overhead costs do not vary with the base. This includes those costs considered fixed within the limit of

expected volume [Ref. 10: 61]. This point is exemplified by the following comment.

For example, the cost of fire insurance is not expected to vary merely because the company anticipates a greater or less amount of plant workload than was accomplished during the past year. Any difference between the proposed cost of insurance the the prior year's cost must be accounted for by such factors as difference in rates or difference in coverages. [Ref. 10: 61]

Comparisons of dollar amounts on those overhead items identified as discretionary may be appropriate because they too do not vary with volume.

Forecasts of increased volume often will place pressures on the company to increase managed costs. This is expecially true after a period of low volume in which some optional expenditures were deferred. [Ref. 10: 62]

Contractors indicated that comparative analysis is a useful tool to evaluate overhead items such as insurance, depreciation, taxes, and other costs considered fixed. In the case of these costs, the comparison of dollar amounts is useful to management in identifying differences. Each cost increase should be evaluated from the prudent business viewpoint after considering the contractor's position.

2. Comparison of Ratios

The researchers found that contractors will use various ratios as a tool to monitor overhead costs. Because, "Forecasts of variable costs always should be compared to similar historical costs by means of ratios" [Ref. 10: 62]. The relationship is simple. If an indirect cost, such as manufacturing supplies, has been found to vary directly and proportionally with manufacturing direct labor, one should

expect a forecast of the cost to bear the same relationship that has prevailed during the past year [Ref. 10: 63]. The process of comparing costs through use of ratios is easier than comparing dollar amounts because there is no management influence over these variable costs [Ref. 10: 63].

There are factors that need to be considered that affect the comparability of ratios. Inflation, reclassification, and change in methods are the factors that may have to be considered when using ratios as a management tool. A reclassification between direct and indirect costs may distort comparisons because both the base and the pool are dissimilar. The impact of a change in methods may complicate the comparability issue. However, "the relationship between a variable cost and its base or another independent variable is best determined through use of regression analysis" [Ref. 10: 65]. The researchers found that some acquisition managers use simple regression analysis to test the relationship and to assess the usefulness of a particular ratio for predicting future costs.

The Hempson Study identified ratio analysis as a tool that acquisition managers can use to evaluate overhead rates and various overhead costs at two defense contractor plants.

Meaningful intercompany comparisons require that ratio factors not only be adjusted to reflect comparable data content but also that their relationship to one another be statistically significant. [Ref. 1: 25]

One contractor indicated in order to use these ratios on an intercompany comparative basis, to assess the relative degree

of cost control between various contractors may be inappropriate. This is predicated on the differences in contractor accounting systems, methods, and corporate strategy, as such, the comparative nature of such tools may be questioned. However, those ratios associated with the people related costs were being used to some degree by various contractors. The ratios identified in the Hempson Study are as follows:

- (1)
$$\frac{\text{People Related Costs}}{\text{Direct Labor Costs}}$$
- (2)
$$\frac{\text{Indirect Employees}}{\text{Direct Employees}}$$
- (3)
$$\frac{\text{Indirect Salaries}}{\text{Indirect Headcount}}$$

[Ref. 1: 27]

When contractors were asked if they used any of these identified ratios in the Hempson Study, some indicated that they use the head count type indicators as a monitoring tool. However, one contractor indicated when ratios are used as an intracompany monitoring tool, the trends and signals that are received will invariable require an in-depth analysis in order to identify the actual causes for the people-related costs and labor mix changes. Likewise, to use these ratios for intercompany comparison the labor mix differences between two contractors may be significant at first glance. However, the differences in employee classification, i.e.,

indirect in one contractor classified as direct in another may account for the difference.

The use of headcount ratios can identify trends in employee mix within a particular contractor. However, headcount ratio analysis may only provide the "red flag" that a mix change may or may not be reasonable. One contractor noted that only after an intensive review of the various components of the people-related costs including compensation, pension costs, insurance, medical benefits, training and other fringe, that cost reduction areas may or may not be identified. In many cases, demographic aspects reflecting the differences in regional salaries, contractor sizes, and the location in a high cost area are not considered with ratio analysis, said one contractor. Therefore, the acquisition manager may be able to identify and use those people-related ratios that their contractors use in monitoring trends, but in most cases an in-depth review of the various components of the people-related expenses will be necessary to identify potential cost reduction areas.

3. Overhead Cost Analysis Package

The researchers found that contractors also use regression analysis as a management tool which complements the use of flexible budgets and variance analysis. The Hempton study highlighted a particular tool called Overhead Cost Analysis Package (OHCAP). It was developed to determine the appropriate indirect labor and overhead costs to be expected at a particular contractor's facility on the basis

of workload [Ref. 13: 1]. The tool also enables the acquisition manager to evaluate those aspects other than workload that affect overhead rates.

a. Overhead Cost Analysis Package Modeling

Advanced Management Systems (AMS) developed and designed the statistically-based computer driven Overhead Cost Analysis Package (OHCAP) which addresses overhead rates as a function of base activity measured in direct labor hours [Ref. 13: 4]. It is not the intent of this research to examine or analyze the actual software used in the model but to highlight the model's utility. The OHCAP compares proposed rates with rates which would be expected from previous actual performance patterns. In developing the tool, AMS selected the manufacturing overhead pool because NAVAIR expressed concern about defining the appropriate indirect labor force that can be expected for a given workload.

As previously indicated, inflation may be a factor affecting comparability of ratios. Because of this, OHCAP utilizes the overhead rate instead of the overhead expense. For manufacturing, the overhead rate is the quotient of overhead expense dollars divided by the direct labor dollars. "Dollars cancel out as a residual effect because inflation is limited to the differential between the inflation rate for overhead expense and that for base dollars" [Ref. 13: 6].

The overhead rate is basically driven by three factors: the workload forecast, (engineering analysis) an assessment of the business environment, and the corporate

strategy. "Changes in any of these three factors will cause a change in the overhead rate" [Ref. 13: 6]. For example, a change in payroll taxes is representative of a change in the environment which will result in higher manufacturing overhead rates. However, an increase in overhead rates which result from a change in corporate strategy or environment are difficult to evaluate because one decision may affect several pools. For example, in order to stay on the leading edge of technology and continue to remain competitive, the decision may be made to develop a new composite material. This will most likely require new facilities, tooling, maintenance, consulting, indirect staffing, depreciation, and utilities.

The AMS study addressed the fact that the ability to evaluate the impact of corporate decisions and workload on overhead rates is hindered due primarily to the volatile nature of the aerospace industry as identified in Chapter IV. The AMS study contends that the use of linear regression techniques are only useful when the base varies by a small percentage. In testing OHCAP, AMS identified contractors with direct labor hour variations in excess of 45% over the historical period analyzed.

OHCAP is based on a non-linear model and incorporates statistical techniques. The AMS model assumes where a high correlation is attained in applying the model to rates previously experienced at various levels of base activity,

overhead rates which fall outside the trend bounds of the actual should reflect the impact of factors other than workload [Ref. 13: 8].

In order to expressly gain an appreciation of the impact that workload, business environment and corporate strategy have on overhead rates, the model was applied during periods of expansion and contraction in the base hours. If actual rates fell within the trend bounds of the line predicted by OHCAP, it provided strong evidence that workload is the dominant factor in determining the overhead rate [Ref. 13: 8]. The results were very encouraging. Over a period of several years, the actual rates were within the trend bounds. An example is shown in Figure 5.8. In 1975, 1979, and 1982 the actual rates clustered around the OHCAP curve. Data contained in these exhibits are disguised.

Excellent correlation was achieved in the following relationships:

1. Manufacturing overhead rate versus net direct hours.
2. Manufacturing indirect labor overhead rate versus total net direct hours.
3. Manufacturing indirect labor plus fringe overhead rates versus total net direct hours.

OHCAP can aid the acquisition manager in analyzing overhead rates. Utilizing the aforementioned relationships the use of the OHCAP modeling technique is illustrated.

The manufacturing overhead rate versus net direct manufacturing hours in Figure 5.9 has a correlation of 98.03%. This extremely high coefficient of determination reveals that

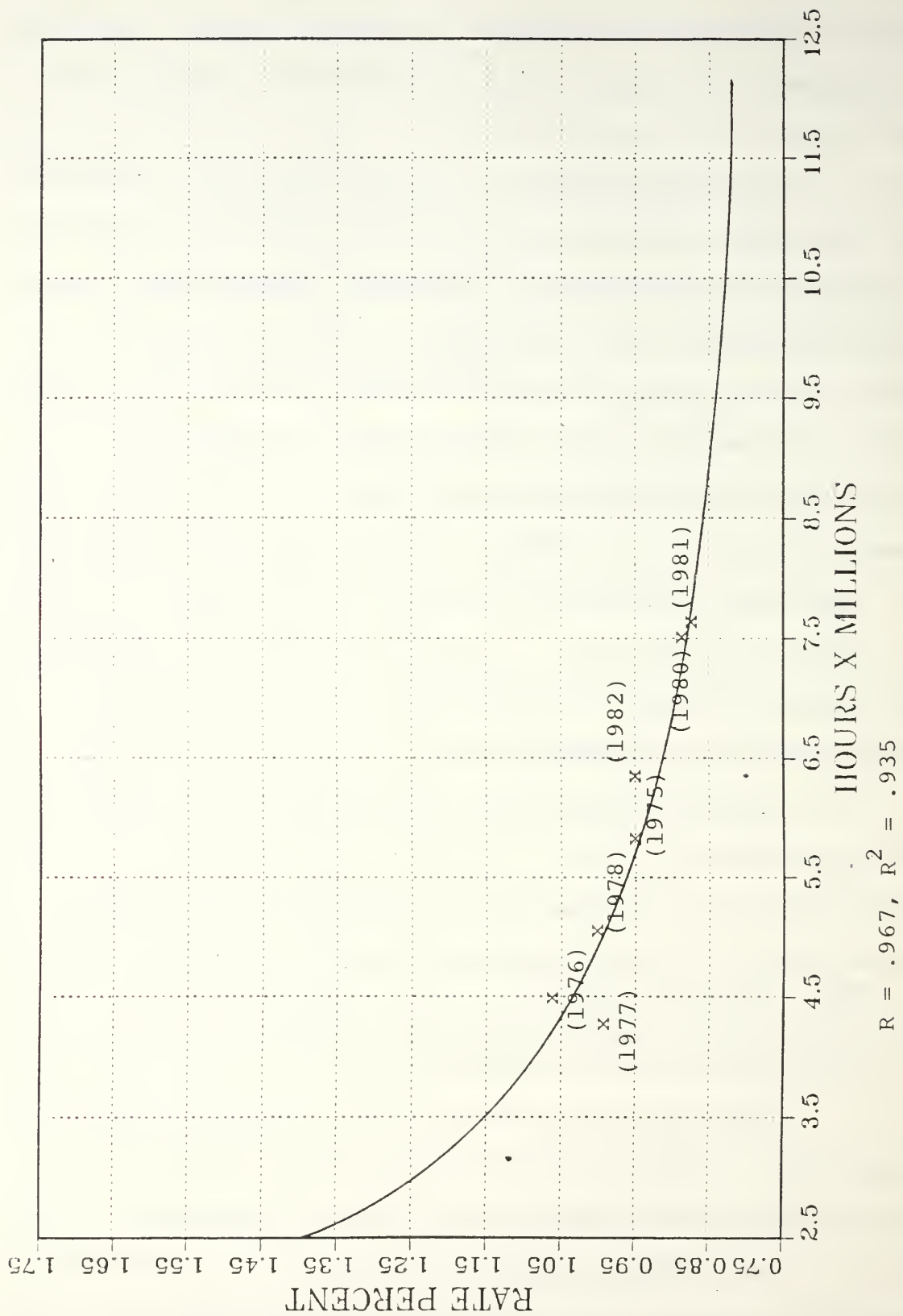


Figure 5.8 RATE VERSUS BASE HOURS (FACTORY

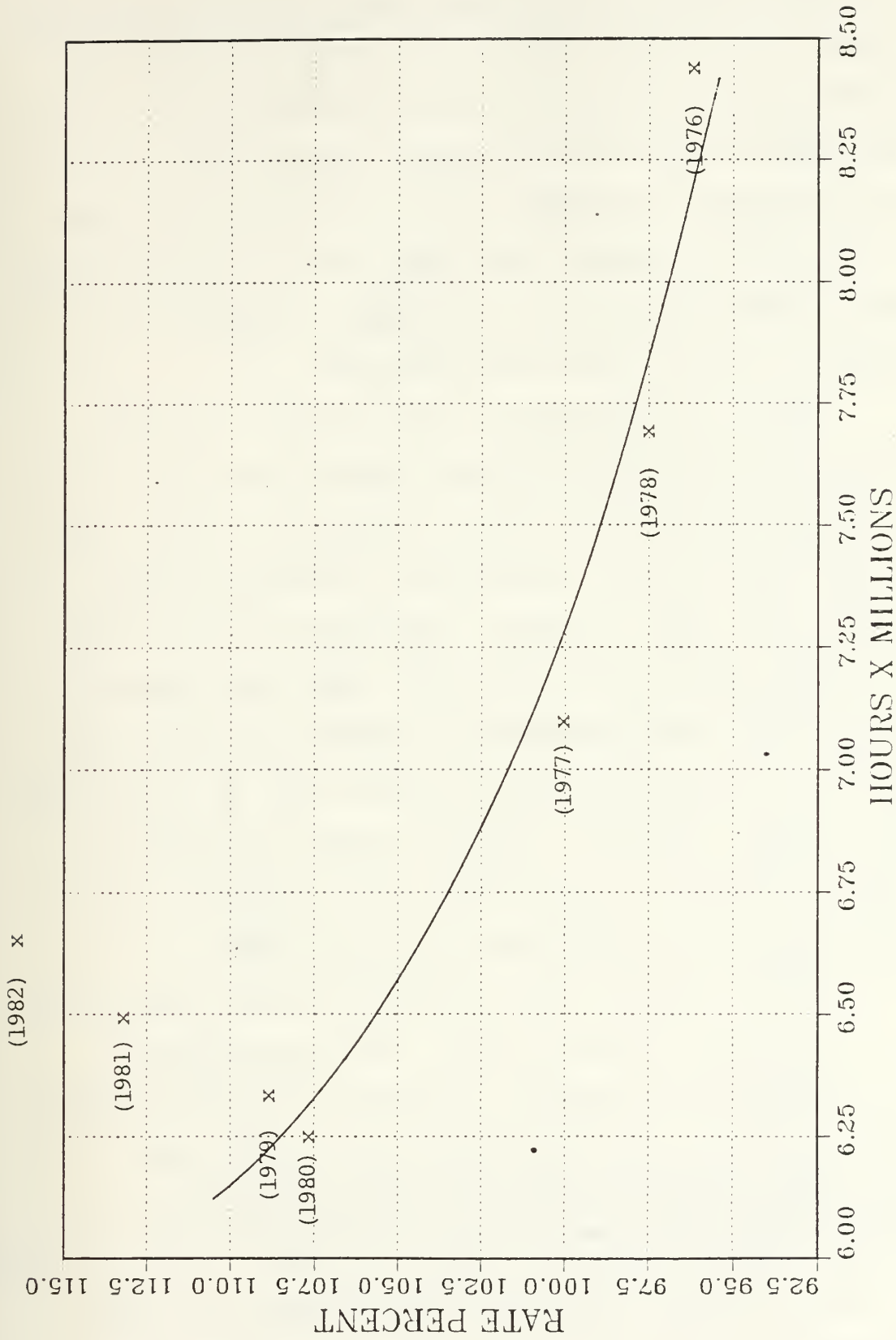


Figure 5.9 MANUFACTURING OVERHEAD RATE VERSUS NET DIRECT HOURS

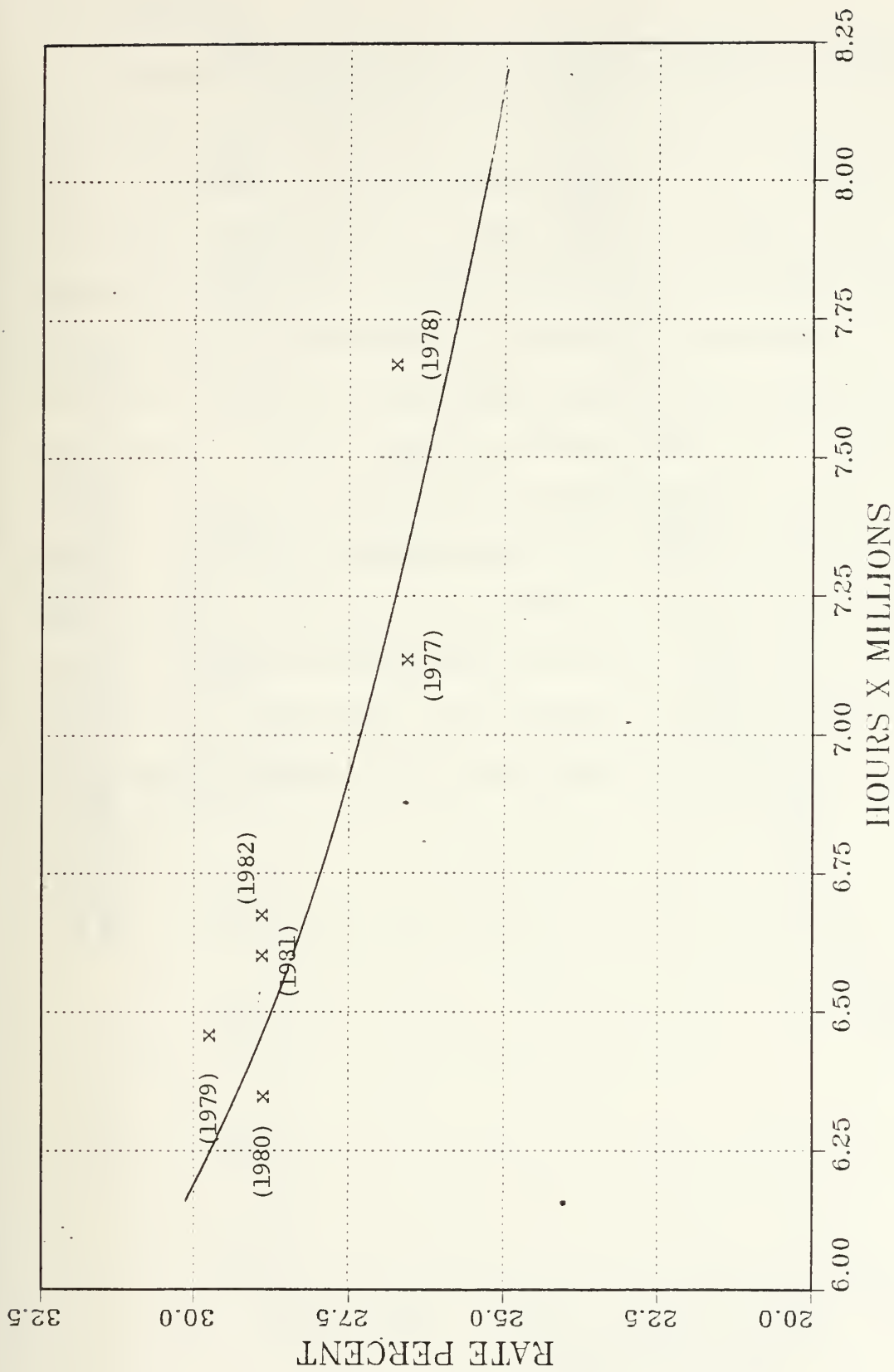
96.1% of the manufacturing overhead rate is explained by the OHCAP curve. The actual rate for 1981 and 1982 exceed the upper limit of the trend bounds by approximately 8-10%. The management line in Figure 5.9 indicates that a rate of 105% would be considered reasonable at a workload of 6.6 million direct labor hours. Rates on the order of 117% contain about 12 points of overhead rate that, according to OHCAP, is attributable to factors other than workload.

Taking the analysis a step further, the OHCAP model for the manufacturing indirect overhead labor rate (Figure 5.10), indicates that for this subpool, a portion of the indirect labor of the manufacturing overhead rate was within the trend bounds. However, when the fringe is added to this subpool (Figure 5.11), the 1982 rate falls outside the trend bounds. This hypothetical example indicates that this portion of the manufacturing overhead rate is not attributable to workload. After an analysis of each line item in this fringe subpool was accomplished, it was evident that the increase was due to increases in payroll taxes.

OHCAP provides a tool that can aid the acquisition manager in evaluating overhead rates. The technique also enables the acquisition manager to evaluate associated subpools.

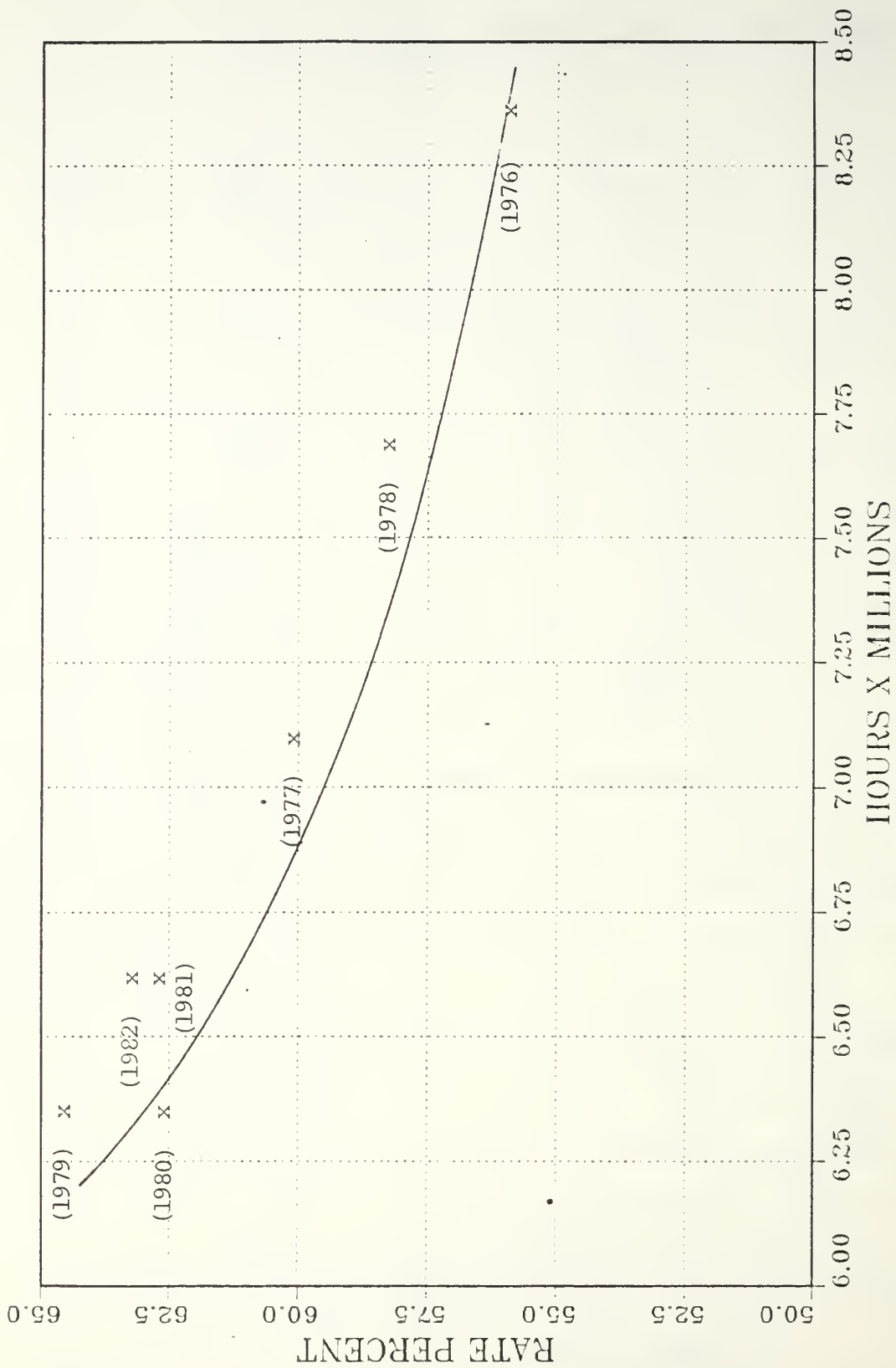
When deviations have been explained they are fed back into the OHCAP algorithm model as either anomalous points (such as a onetime increase in perishable tool charges) or permanent changes to the model (such as an increase in payroll taxes). [Ref. 13: 16]

However, one of the most significant aspects that the OHCAP model provides is a vehicle to identify factors other than changes in the workload that impact rate changes.



$$R = 96.09, \quad R^2 = 92.33$$

Figure 5.10 MANUFACTURING INDIRECT LABOR OVERHEAD RATE
VERSUS NET DIRECT HOURS



$$R = 97, \quad R^2 = 94.1$$

Figure 5.11 MANUFACTURING INDIRECT LABOR AND FRINGE OVERHEAD VERSUS NET DIRECT HOURS

D. SUMMARY

The management indicators contained in this chapter are representative of those used by contractors as well as acquisition managers in monitoring indirect costs. The contractor's planning, budgeting and control system provides clues or indication that the indirect costs are or are not being scrutinized by management. An effective planning, budgeting and control system can provide those clues. The use of flexible budgets can be a useful planning tool. The utilization of the industrial engineering estimates can be appropriate tools in judging reasonableness of proposed costs before they are incurred. The use of variance analysis can aid the acquisition manager in monitoring the actual indirect costs to the approved planned costs. And finally, OHCAP provides the acquisition manager with a rate monitoring tool.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Acquisition managers should use the same management indicators that contractors use in monitoring their overhead costs.

Contractors differ in the number and types of programs they manage. They differ with regard to the level of research and development efforts, their managerial policies, accounting and cost classifications, organizational titles and job descriptions. Finally, they each possess their own company unique planning, budgeting and control systems.

Contractors indicated that various administrative as well as other indicators may alert management to potential areas where control needs strengthening. For example, the use of appropriate headcount indicators can provide management with information on indirect staffing trends. Some contractors utilize variance analysis as an appropriate tool to assess budget execution and make adjustments where necessary.

What can be concluded about management indicators is that each contractor utilizes various tools to monitor their particular overhead cost control. A contractor that portends to be very cost conscious may utilize more management indicators than a contractor that views cost control differently. Many of these indicators were identified in Chapter V. The researchers found that under certain circumstances, such as a substantial change in the projected volume, contractors may

utilize some indicators over others. The use of the headcount indicators for example, can highlight potential personnel growth problems in times of a reduced business base. In order to account for like circumstances, the acquisition manager should be utilizing the same management indicators that the contractor uses in assessing their particular overhead cost control.

The researchers identified administrative indicators, forecasting indicators and performance monitoring indicators that various contractors use. Inconsistent patterns from these indicators in combination may provide persuasive evidence that additional study into an overhead control problem is justified. Therefore, in order for Government acquisition managers to improve overhead cost monitoring, it is concluded that they could use the same indicators that their respective contractors use in assessing overhead cost control.

2. Management indicators used to monitor people-related costs tend to identify areas that lend themselves to more immediate improved overhead cost control.

This is based on the fact that people-related costs lend themselves to increased management discretion over those costs that are of the non-controllable nature. The researchers found that indirect staffing decisions are basically discretionary by management and many of those positions do not vary with business volume. Unfavorable trends in indirect staffing during periods of reduced capacity utilization may necessitate further investigation. Management of people-related costs was

found to be a powerful tool in assessing the contractor's cost control program, because it constitutes the major cost drivers of overhead. People-related costs are those indirect costs that management has perhaps the greatest discretion over. Monitoring this area may identify areas where immediate cost control or reduction can be attained.

3. Management indicators should be categorized as to their particular degree of usefulness.

The researchers found that some indicators may be more useful than others. One contractor pointed out that during periods where the business volume is experiencing significant changes, the use of the planning tools becomes very important. For instance, the flexible budget can provide the contractor with an estimate of what a particular budget should approximate at various base levels. Another contractor indicated that their most useful management tool was the use of variance analysis and an assessment made on the corrective actions taken. Each contractor may indicate that they prefer one management indicator over another. The researchers found that their hierarchy of needs may differ. As such the acquisition manager would do well to highlight which indicators his particular contractor is using and determine which ones provide the best overhead cost information.

4. Management indicators should be used by acquisition managers in striving for cost avoidance.

Chapter V identified the various indicators that contractors use in assessing their particular overhead cost control. Acquisition managers should be able to use like indicators

to convey the concept that cost avoidance is perhaps a more effective policy than the disallowance of costs after the dollars have already been spent. The use of flexible budgeting, variance analysis, dollar comparisons, headcount ratios, and even the Overhead Cost Analysis Package (OHCAP) model can highlight areas to management that may lend themselves to cost reduction measures and hence cost avoidance.

5. Overhead costs are representative of the most difficult portion of total costs to monitor.

Management of these costs has long been recognized as one of the most difficult in cost management. There are many aspects at work that impact overhead costs. Those aspects were identified in Chapters II, III, and IV. Due to the complexity and the nature of the aerospace environment, coupled with complex cost collection and accounting systems, the acquisition manager's monitoring responsibilities have been complicated.

6. Comparing one contractor against another contractor has been impractical.

Contractors differ in the number and types of programs they manage. They may differ with regards to the level of technical advancements, their managerial policies, accounting systems, organizational titles and job descriptions. And finally, they each possess their own company unique planning, budgeting and control systems.

B. RECOMMENDATIONS

1. In order to monitor overhead cost control, it is recommended that acquisition managers develop a management information data bank of indicators that their particular contractors use.

This research identifies indicators that both the contractor and the Government acquisition manager can use together. These tools aid contractors in monitoring their overhead cost control. Indicators found in the contractor's planning, budgeting and control system provide signals concerning the corporate overhead cost control culture. Some tools provide the contractor with a planning assessment and some a forecasting tool. Therefore, it is recommended that experienced Government acquisition managers at contractor locations develop a management information data bank containing their contractor-unique indicators, their use, their utility, and which indicators are the most useful. This collection of indicators may provide the acquisition manager with an effective monitoring system.

2. It is recommended that emphasis on cost control be placed initially on monitoring the spectrum of people-related costs.

Acquisition managers should monitor each of their contractor's people-related costs always being cognizant that each might be different. However, the people-related costs are costs that lend themselves to increased management review because they can be analyzed, budgeted, and adjusted upwards or downwards in an immediate fashion.

3. It is recommended that acquisition managers identify their contractor's most useful indicators in developing the management information data bank.

When developing an overhead management information data bank for a particular contractor, the acquisition manager should highlight those indicators that are considered more useful than others by the contractor. The researchers found that contractor personnel were willing to share their particular tools of the trade used in monitoring their overhead cost control. Some indicators were viewed differently by various contractors. For instance, ratio analysis for some contractors was a very popular tool. But for others, ratio analysis was deceiving, because of accounting changes and method changes rendering comparability ineffective. Therefore, it is recommended that acquisition managers embark on a cooperative basis with their respective contractors in identifying their most useful indicators then develop an appropriate management information data bank.

4. It is recommended that the various management indicators identified in this study be used as one of the tools in assessing overhead reasonableness.

By using like indicators, acquisition managers may be able to reasonably highlight or bring to the contractor's attention where cost avoidance measures can be instituted. These tools and the information that they reveal may become valuable for both contractor and Government. Actions taken by the contractor based on management indicators may provide the acquisition manager with an assessment as to the

contractor's cost avoidance measures. Likewise, acquisition managers may be able to identify where potential overhead control problems may be building in order that corrective action may be taken by the contractor.

C. ANSWERS TO RESEARCH QUESTIONS

How can management indicators concerning overhead costs in the aerospace industry be used by Navy acquisition managers in evaluating and monitoring cost control? This was the central theme of the research. The researchers felt that in order to answer this question the acquisition manager should understand the basic background, theory and history that impact overhead costs. Additionally, the researchers wanted to provide the reader with a background on the aerospace contractor's business environment and strategy, because their strategy ultimately affects overhead. In order to answer the central question, five subsidiary questions were developed.

1. What are the key management indicators used to evaluate and monitor aerospace contractors and what has been their intended focus?

The key management indicators were categorized in five areas. The first identified administrative indicators. They included various indicators that an effective planning, budgeting and control system could provide management. Their intended focus has been to alert management to unfavorable and favorable overhead decisions within a particular company, and administrative indicators that can aid the acquisition manager in assessing contractor's overhead cost control culture.

Secondly, variance analysis was identified as a performance monitoring tool that various contractors use. Its intended focus has been to alert management that corrective action may be necessary to bring actual overhead expenditures in line with budgeted overhead. The next category identified the use of dollar comparison and the use of ratio analysis. The intended focus of the dollar comparisons have been relegated to those overhead costs that primarily do not vary with volume. Headcount ratios are useful in determining if the workforce mix is changing. It provides management with a signal that if the ratio of indirect to direct employees is continually shifting, further investigation may be warranted. And finally, OHCAP was presented as a useful tool to monitor overhead rates. Its intended focus is to provide management with a rate forecasting as well as monitoring tool.

2. How have these indicators been utilized?

The tools examined are only identifiers or indicators that an overhead control problem may exist. They provide the appropriate red flag or alarm. However, many potential problems require full investigation on the part of the acquisition manager. Therefore, one could say that the intended focus of the management indicators is to provide a warning that an overhead control problem may exist.

3. What are the key issues and problems in the use of management indicators?

The researchers found that there is no easy answer to what constitutes an optimal cost structure because many

overhead decisions are judgmental. Therefore for some indicators there are some aspects that affect their utility. For instance, ratios and their use are affected in inflation, changes in classification methods or a change in accounting systems making year-to-year comparisons difficult. Some indicators will be applicable to only one contractor making comparisons between contractors impractical.

4. How should management indicators be applied in order to effectively determine that contractors are properly controlling overhead costs?

No one indicator is indicative that further analysis may be required, but collectively one or more tools may establish an unreasonable trend that may warrant investigation. For instance the use of a flexible budget technique in the manufacturing overhead pool will aid the acquisition manager in identifying potential volume and spending variances. OHCAP can identify changes in a particular rate due to changes based on business and environmental causes.

5. What new management indicators are appropriate in order to increase the Navy's ability to monitor contractor overhead cost control?

Of those indicators evaluated, the OHCAP modeling technique is the most recent effective indicator that was developed in order to monitor contractor overhead cost control. The tool is innovative in that it identifies causes other than workload changes that impact overhead rates. If implemented correctly, the tool is appropriate because the model built for a particular contractor can be adjusted periodically to

reflect changes in corporate strategy and business environment. It could be a useful tool to the acquisition manager in negotiating overhead rates.

D. RECOMMENDATIONS FOR FURTHER STUDY

Research conducted for this report has provided the basis for further study and action in the following areas:

1. A study be conducted by the Navy identifying areas where cost reduction actions on the part of the contractor and Government can be realized.
2. The effect a Forward Pricing Rate Agreement has on overhead cost control versus controls of a contract not under a negotiated Forward Pricing Rate Agreement in the aerospace industry.

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